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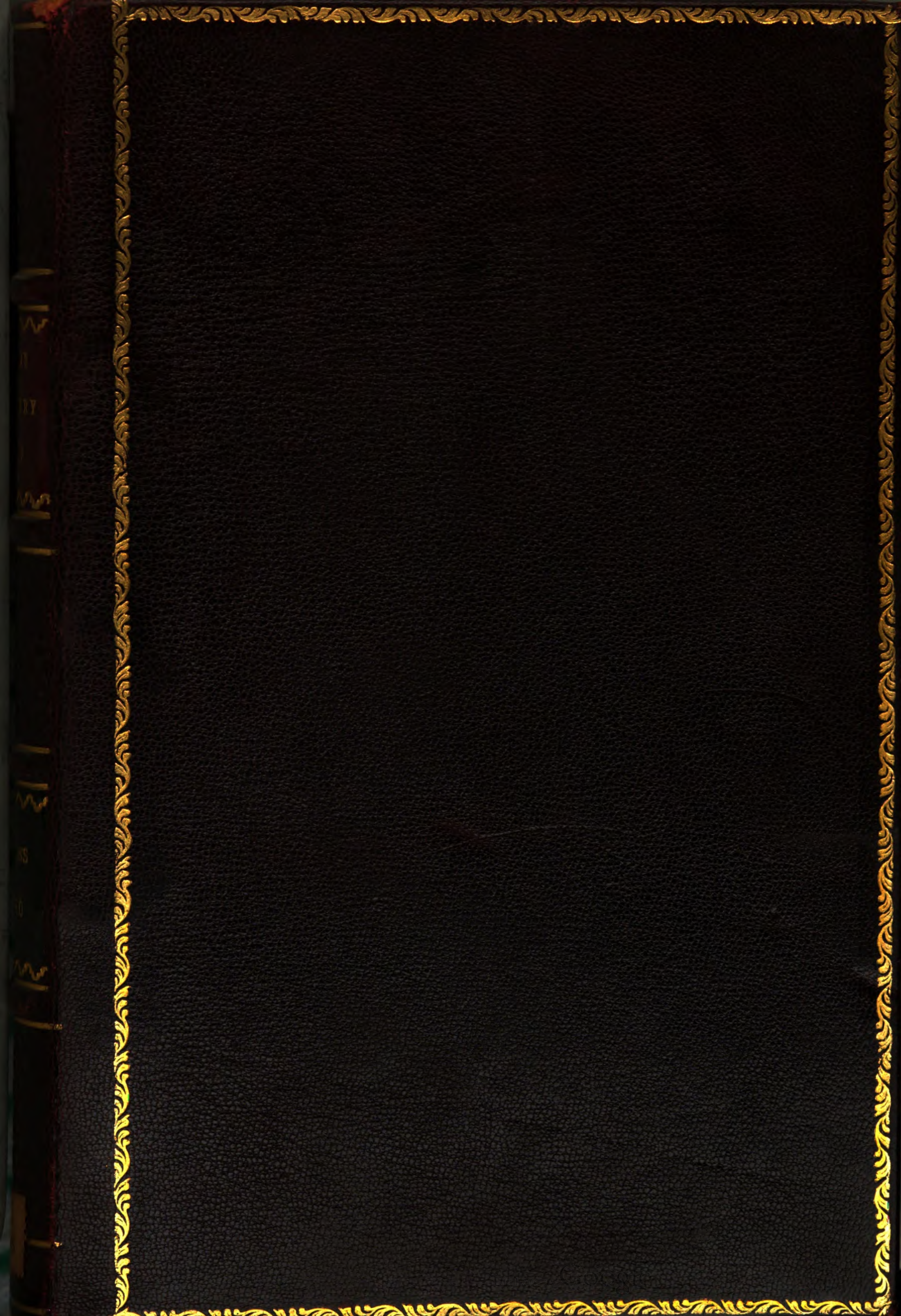

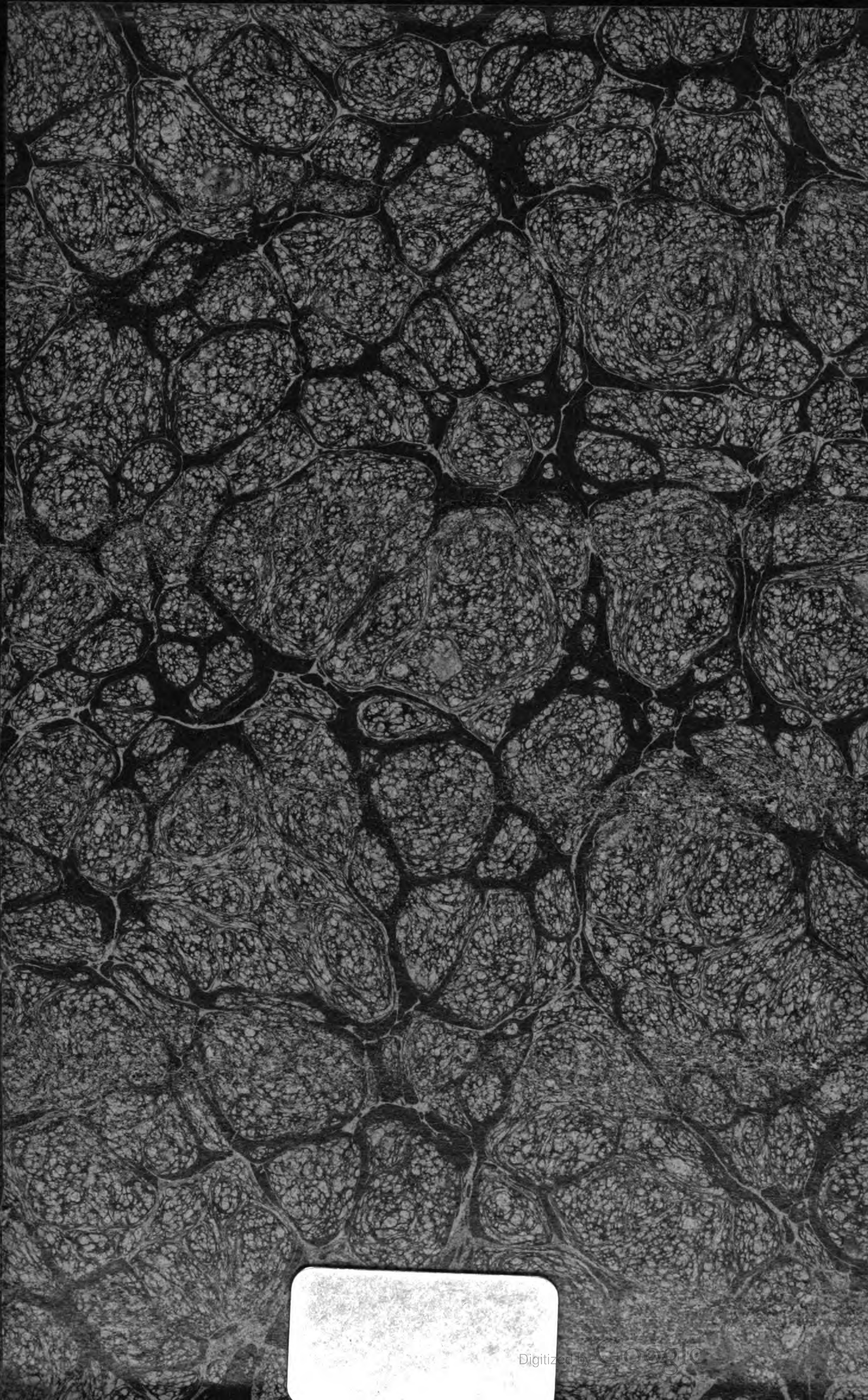

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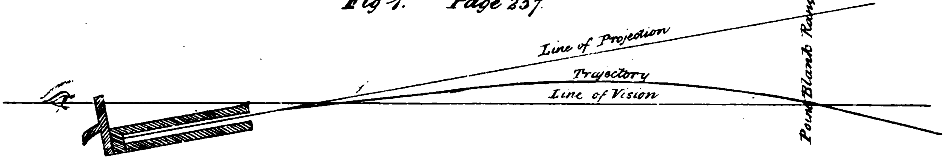
Figures in Illustration of Extracts from "the Soldier's Manual of Rifle Firing at various distances

(Plate. 1.)

Fig 1. Page 257.



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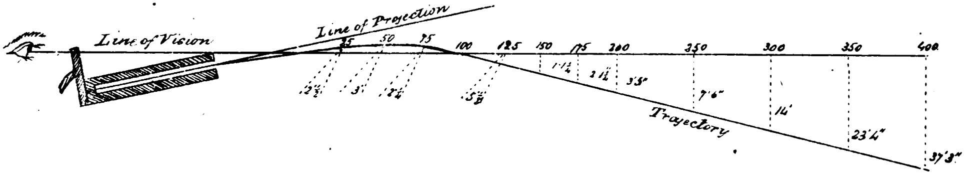
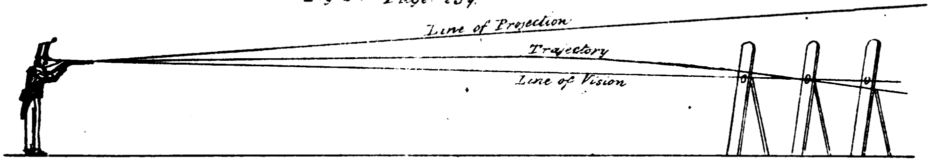


Fig 3. Page 259.



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Extracts from "the Soldier's Manual of Rifle Firing, at various distances."

Taking Aim and Firing.

The general principles of taking aim and firing applicable to all fire-arms, are founded on the relative positions existing between three imaginary lines:

1 The line of projection; | 2 The trajectory;
3 The line of vision.

These lines are shown in fig. 1, Plate 1.

The line of projection is a right or straight line drawn through the axis or centre of the barrel of the rifle lengthways, and extending beyond the barrel to any supposed length.

The trajectory is a curved or bent line followed or taken by the ball in its progress through the air from the rifle to the object.

The line of vision is a right or straight line passing through the centre of the back sight on the rifle and the centre of the front sight near the muzzle of the rifle to the object.

Now in order to the certain understanding of these lines, after having studied them in fig. 1, Plate 1, lay a rifle down on a table, and with a piece of chalk, drawn a straight line on the table from the centre lengthways of the barrel—this will be the line of projection.

Draw another straight line through the sights—this will be the line of vision.

Draw another curved or bent line beginning in the same direction with the line of projection and afterwards crossing the line of vision at two points, as shown in fig. 1, Plate 1, —this will be the trajectory.

It is absolutely, necessary before going further, to study these lines, in order thoroughly to understand them, for a correct knowledge of them lies at the very foundation of good rifle firing.

It may be as well here to explain the principles affecting the passage of the ball from the rifle, by which the reason of the curve forming the trajectory will be readily understood.

A projectile—a ball for example—thrown in any given direction by any force, as for instance, the force of powder exploded in a Rifle, would, by virtue of the law of inertia, or the indisposition of matter to change its state of rest or motion, continue always to proceed in the same direction with the same velocity, if it did not suffer or meet with some opposing force or resistance in a direction differing from that first given to it. Now, in the case of a ball fired from a rifle, there are two opposing forces. First, the attraction of gravitation to the earth's centre ; secondly, the resistance of the atmosphere or air, the former drawing the ball continually towards the earth, and the latter diminishing continually its velocity. On the ball first issuing from the rifle, the velocity imparted to it by the powder is so great, that it almost wholly overcomes the two opposing forces, and therefore proceeds nearly in a straight or right line with the axis of the barrel, or in other words, with the line of projection; but as it proceeds, these two resisting forces come into more powerful operation, and as the velocity is diminished by the resistance of the atmosphere or air, the attraction of gravitation increases in intensity, or operates more powerfully. Instead, therefore, of proceeding in a straight line, the ball thus acted upon, and continually drawn downwards, after crossing near the muzzle the line of vision, is compelled to travel in a curve: this curve, or the course described by the projectile in its passage through the air, is called the trajectory.

There is another and very simple manner of shewing the principle of the trajectory which is familiar to every one—the common act of throwing a stone. We know that if we throw a stone, it has a tendency from the moment it leaves the hand, to fall to the earth; and we therefore, if we wish to strike an object beyond a certain distance, throw the stone higher into the air, in order that it may not reach the earth at a point nearer to us than the object. The stone, in the same manner as the ball fired from the rifle, forms a curved line from the moment that the force given to it by the hand ceases to be sufficient to overcome the effect of the attraction of gravitation.

This curved line is in effect the trajectory. The stone may be considered as the rifle ball, and the hand as the rifle. The point where the trajectory the second time crosses the line of vision (figs. I, III., Plate 1) is called the point-blank range, which should be the centre of the object to be struck.

We shall now explain some other points necessary to be understood.

The angle of projection is the angle that the line of projection forms with the horizon, or popularly speaking, with the visible surface of the earth at the moment of firing.

The angle of vision is the angle formed by the line of vision with the line of projection.

A plane which is vertical, and contains the line of projection at the moment of firing, is called the plane of projection.

The trajectory is wholly in this plane. It is at first coincident, or similar to the line of projection, but afterwards diverges or deviates from it, more and more, as the ball's distance from the muzzle of the rifle is increased.

When the line of vision is horizontal, and placed in the plane of projection, the angle of vision is equal to the angle of projection.

The trajectory and the line of vision may be considered as invariably related, when the latter of these lines is in the plane of projection.

In this case, if the line of vision be raised or depressed, or be directed to the right or left, the trajectory participates in these different movements, and always preserves in all its parts the same position relatively to the line of vision, provided that too great an inclination above or below the horizon be not given to it.

Since the trajectory is contained in the plane of projection, if care be taken to place the line of vision in this plane, and to direct this line on the vertical passing through the point to be attained, the ball will touch in some part the vertical in question, if such line be not without the limits of the range. In order that this point of contact shall be precisely the object to be struck, it only remains to direct the line of vision, or what is the same, the visual ray passing along the bottom of the notch or the sight and the top of the guide, on such a point of the vertical that the trajectory should cut the object.

The point in question will be determined when it is known how much the trajectory rises above, or descends below the line of vision, at the distance between the object and the muzzle of the rifle.

If, for example, it be known that the trajectory, at a certain distance, descends a yard below the line of vision, it will be necessary, in order to strike an object situate at such distance, to direct the line of vision, or, in other words, to take aim a yard above such object. For if the line of vision were directed, or aim were taken, exactly to such object, the ball or trajectory would pass a yard below it, as shewn in Fig. II. Plate 1. But if the line of vision be directed, or aim be taken, a yard above the object, the trajectory will follow the movement of the line of vision; will preserve, with reference to this, its first position; and will, consequently, pass a yard below the point sighted—that is, will exactly meet the object.

It must be kept in mind that the line of vision is placed in the plane of projection, when at the moment of firing, the notch of the back-sight and the top of the sight near the muzzle of the barrel are not inclined either to the right or left of a vertical plane leading to the eye, and passing by the middle of the barrel lengthways; and care must, therefore, be taken to hold the Rifle so that the sight is directly vertical, or in popular language upright.

The firing of the Rifle can then be regulated by means of the line of vision, when the position of different points of the trajectory relatively to this right line is known, and when care is taken to place the two points, which determine the line of vision in the place of projection.

If the trajectory and the line of vision, in the position which they generally occupy with relation to each other, be examined, it will be observed that the line of vision cuts or intersects the trajectory at two points, one very near the muzzle of the Rifle, and the other at a greater distance.

The second point of intersection of the trajectory and the line of vision, is called the point-blank range, as has before been stated.

To each line of vision a special point-blank range corresponds.

The point-blank range is increased in proportion as the notch or opening of the sight of the Rifle is raised, or the requisite elevation is given.

It will be observed (Fig. II, Plate 1), that beyond the point-blank range the trajectory descends below the line of vision, and the more so as the ball's distance from the Rifle is increased.

That within the point-blank range, between the two points of intersection of the line of vision and the trajectory, the ball rises above the line of vision in different degrees according to the position under consideration.

That the elevation of the ball is very small near the points of intersection, and greater towards the middle of the right line, or line of vision, which joins these two points.

That from the muzzle of the Rifle to the first intersection, the centre of the ball is below the line of vision in different degrees, according to the point from which the centre of the ball is considered or taken; but these degrees are all very small, so that in this part of its course the ball may be regarded practically as being on the line of vision.

Since at a distance equal to the point-blank range the trajectory meets the line of vision, it will be sufficient to direct the line of vision on such point to strike an object situated at that distance.

Since beyond the point-blank range the trajectory descends below the line of vision, it will be necessary, in order to strike an object situate at a greater distance than the point-blank range, to direct the line of aim above the object, for if it were directed straight to the object, the trajectory would pass below it.

To determine the elevation of the sight to be taken so as to strike the object, it is only necessary to know the descent of the trajectory below the line of vision at the distance at which the object to be struck is placed. This descent is equal to the elevation that should be taken above the object. This will be evident when it is remembered that the trajectory is relatively connected with the line of vision.

It will be equally clear that to strike an object situate between the two intersections of the line of vision, and the trajectory, a sight must be taken below the object at a point vertically distant from the first or line of vision, of a length equal to that which separates the trajectory from the line of vision at the distance at which the object to be struck is placed.

It must be observed that to strike an object at the same distance from the muzzle of the Rifle, as the first intersection of the line of vision and the trajectory, the object must be aimed at directly.

Such are the general conditions for firing, which may be reduced to the general following rules:—

When the object is situate at one of the points of intersection of the trajectory and the line of vision, the object itself must be aimed at.

When the object is situate between the two points of intersection, an aim must be taken below the object.

When the object is situate beyond the point-blank range, or the second point of intersection of the line of vision and the trajectory, an aim must be taken above the object, and the further the object is removed, the higher must be relatively the aim.

When the object is situate between the muzzle of the Rifle and the first point of intersection, an aim must be taken above the object.

These general principles being well understood, the next point will be to reduce them to practice.

Since sights on the Rifle are provided so as to indicate the range, or in other words the point-blank, where the trajectory the second time cuts or crosses the line of vision, the foregoing observations are intended chiefly for the information of the soldier on the theory of Rifle firing rather than for any practical necessity, and the same reason will render useless our entering here into any mathematical calculations to determine the point-blank range for given distances. No other operation will be required on the part of the soldier, than merely regulating the sight corresponding with the distance, as shewn by the graduated scale of the sight.

The explanation of this graduated scale, and the means of adapting it, will lie with the instructor, by whom a very short tuition will render the soldier thoroughly competent on this point.

The first part of the instruction of Rifle firing may commence in the barrack room or yards, and should consist in the instructor pointing out to each man individually the nature of the sights on the Rifle, their use as affecting the range, the mode of shifting them, and how to point and level the Rifle at all distances.

The soldier's first practice will be accurately to take aim,—for this purpose a *traversing rest* should be provided; this is a piece of wood scooped out to receive the Rifle, placed on a stand, and capable of being elevated, depressed, or made to traverse or turn at will; or in the absence of this, an ordinary sand bag may be placed on the barrack table or window sill. On this rest, or sand bag, the soldier should place his Rifle, and take an aim, using the sight appropriated to some given distance;—the best object for this practice will be a straight rod placed quite upright.

Having taken aim, the soldier should leave his Rifle on the rest, which should be examined by the instructor to ascertain that the sight is properly adapted, that the front and back sights, and the object exactly cover each other, and that the aim is perfectly true.

When the aim is ascertained by the instructor to be correct, he should fold down the elevating or back sight on the barrel, desiring the man to look again along the barrel, in order that he may form an idea of the amount of elevation that was required to attain the range named.

The instructor should also see that the sight, and back sight, are perfectly vertical or upright, and not inclining either to the right or left, since, if they should so incline to the right or to the left, the trajectory and line of vision will not lie in the same vertical or upright plane, and consequently will not intersect each other, and the ball will consequently not strike the object aimed at. It seems to be understood, at least in the lower ranges marked on the scale of the sights, that either an elevation or depression of two feet on the face of the target, will make a difference of about thirty yards in the extent of range.

This practice should be continued for a sufficient length of time to render the soldier perfectly conversant with the various sights, and competent to take aim correctly. When this shall have been accomplished, the soldier must go through the same exercise with the Rifle held to his shoulder, instead of being placed on a rest.

For this purpose he must be carefully taught by the instructor the mode of holding the Rifle, so as to ensure its being quite steady; and the mode of pressing the trigger, so as not to occasion any change of position of the Rifle in firing.

The Rifle should be held by the left hand, placed so far forward as not to occasion any inconvenience in the posture—since the further the hand is extended the more equal will be the comparative leverage or balance of the Rifle on either side of the hand, and the greater will be the facility of holding it perfectly steady. A pressure towards the shoulder will be exerted by the left hand, which will also contribute to the steadying of the Rifle. The right hand will hold the Rifle clasping it below the trigger guard, and will press the butt firmly to the shoulder, being assisted in steadying the Rifle by the inner and lower part of the right arm. The first or trigger finger must be placed lightly on the trigger, so that in firing its only motion will be very gradually to press the trigger without the slightest jerk, since if it be placed at any distance from the trigger, the movement towards the trigger for the purpose of pulling it, will most probably cause a deviation in the direction of the Rifle. The second joint of the first finger should be placed on the trigger, and used to pull it; and the trigger must be pressed by the finger without any jerk or movement of the elbow.

A very important point to observe is, that from the moment of finally taking aim until after the firing, the breathing should be stopped, so that the motion of the chest in taking breath do not change the position of the Rifle.

For the purpose of taking aim the head should be inclined, or leaned down a little to the right, so as to bring the right eye immediately over the tangent or back sight, and in a line with the sight at the muzzle or the barrel. Aim must be taken with the right eye, the left eye being closed.

In order to enable the instructor to determine the precision of aim by the soldier, during this process of preliminary instruction of firing from the shoulder, the instructor placing himself about ten or twelve yards in front of the soldier, and telling him to aim at his right eye, will be able to ascertain if the soldier has acquired the necessary requisites for aiming correctly.

The next point will be to practice the soldier in taking aim at an object at any assigned distance, and as to this the duties of the instructor must necessarily be confined to seeing that the proper sights are used, that the rifle is held in the proper position, and that the trigger finger is so placed and used, as not to cause a deviation from the line of aim.

The sights are graduated or marked with various distances, from 200 up to 1000 yards. The first and last of these are fixed and immovable, but the others are regulated by means of a sliding bar, which may be placed at pleasure at any intermediate distance between 400 and 1000 yards.

In directing the rifle at any object, therefore, less than 200 yards, if the sight for 200 yards be used, it will be necessary to make allowance for the difference, and to aim proportionably below the object; and so if the 400 yard sight should be used for an object at less than that distance. But if the 200 yard sight be used for an object beyond that distance, an aim proportionably above the object must be taken, and so for the 400 yard sight, if it be used for an object beyond it.

The other sights will necessarily be adjusted by the sliding bar accurately, with respect to the exact distance of the object.

The point of an object at which aim should be taken, if it be at point-blank range, is the centre—if it be near, but within point blank range, the lower part—and, if near, but without point-blank range, the upper part.

In this first part of the practice of firing from the shoulder, the trigger is of course to be pulled so that the cock will fall; but in this case, precaution must be taken by placing a small piece of leather, or India-rubber, around the nipple, that the cock be not broken in falling on the nipple, in the absence of the cap.

This will be followed by firing with blank cartridge, and subsequently with ball.

In ball-firing, care must be taken by the officer, that, so far as he can control it, no portion of the powder in the cartridge should be lost; and the men must, therefore, be charged to be particularly careful in biting off the end of the cartridge, not to suffer any portion of the powder to be wasted, since all difference in the quantity of powder will make a corresponding difference in the range of the rifle; the cartridges being carefully prepared in relation to the sights on the rifles.

In ball firing, the soldier must begin to aim below the object to be hit, by gradually raising the muzzle of the rifle in a straight line up to the object (or bull's-eye), and at that instant the trigger should be pressed, and the piece discharged —for the following reason:—As long as you preserve the vertical or upright motion, no lateral motion can take place; but if your aim was taken at the object to be struck for any length of time, say a few seconds only, your Musket or Rifle would be forming a circle around the object to be struck.

In the first period of ball practice, it would be well to place a target of eight feet diameter at a short distance, say fifty yards, in order to give confidence to the men, and to detect more easily their incompetence in taking precise aim; and it would be advisable to continue the practice with this target, until they have acquired a certain proficiency.

This practice may be varied by the men firing sometimes from the knee, and sometimes standing.

After the men have shewn a tolerable proficiency in firing at this first target, it would be well to place a second target at a certain distance—say 30 or 40 yards behind it, as in fig. III, Plate 1. The ball, having passed through the first target, would then pass through the second target at a higher or lower point, and would thus afford a means of shewing practically, and explaining to the men the line of projection, the trajectory, and the line of vision.

So soon as the firing at this first target should have acquired something like perfection, the distance may be increased, and targets of the ordinary dimensions of 6 feet by 2 may be used: they should be painted black or white, according to the colour of the objects opposed to them, with a white or black spot, or bull's-eye of 6 inches in diameter, in the centre. They should be divided into three squares by two horizontal lines. These divisions are called the upper, the centre, and lower divisions of the target.

Up to 225 yards, the practice will be at a single target.

From 225 to 300, at two,
From 325 to 400, at three,
From 425 to 500, at four,
From 600...........at five,
From 700...........at six,
From 800...........at eight targets.

The targets being placed very near together.

It may be observed, that the ranges are marked on the scale of the sight, in the supposition that the sights have in every instance been placed with perfect accuracy, but the soldier will be prepared to discover some peculiarity in his own musket or rifle, for which allowance must be made, and must not be discouraged if even, having found a means of remedying its defects, he does not always hit the mark, or make equally good practice. There are various causes, which will be more particularly detailed hereafter, which may operate against him, but for which, when he becomes sufficiently experienced, he will be able to make due allowance, so as to reduce or counteract their effects.

Estimation of Distances.

We have considered the principles and practice of firing; but it will easily be conceived that how important soever these may be, and certainly are, the just appreciation or estimation of distances at which the object fired at may be, is of equal or even of greater importance. It is impossible, indeed, to bring into effect the rules we have laid down, if the soldier cannot pretty accurately judge of the distance of the object which he has to strike, the rules for firing at such or such a distance, having reference only to the prescribed distance.

Continued trials and frequent observation can alone confer a habit of judging of distances, and that readiness and quickness in deciding on them, which are absolutely essential to make an expert marksman.

In firing at the target, or otherwise simply for practice, the distances are measured and well known, and nothing is required but to aim correctly, and to fire with care and attention to the rules prescribed; but when the soldier is opposed to an enemy, the distance is necessarily unknown, and it is absolutely essential to decide with promptitude, and as exactly as possible the distance, and to regulate the firing accordingly.

The estimation of distances is made either by simply judging of them by sight, or by the aid of instruments.

We shall first consider the means of acquiring facility of judging of distances simply by sight.

A distance, say of 200 yards, will be measured off by a chain, and divided by some marks, such as small sticks stuck in the ground, small stones, or scratches made in the ground, into distances of 50, 100, 150, and 200 yards. The men will then be made to pace this ground so marked, stepping in their ordinary manner, without increasing or lessening their usual mode of stepping. They will be directed to count the number of paces in each 50 yards, and to continue this until they shall have attained an equal number of paces in each 50 yards. They will take the same course as to 100 yards.

When this shall have been accomplished, they will begin again at the commencement of the 200 yards, and pace over the whole distance, until they shall be able to pace the 200 yards in double the number of paces they took for 100 yards.

When they shall be proficient in this, they will leave the ground that has been measured off, and go to another ground, and there pace 25, 50, 100, 150, and 200 yards, until they shall have acquired a complete facility in pacing any distance within 200 yards. They will mark the distances they pace on this unmeasured ground, and they will be checked by being measured with the chain by the instructor ; and this exercise they will continue until they are quite competent to pace any assigned distance, less than 200 yards, correctly.

In all these exercises there must be placed at the point from which the soldier departs, some mark sufficiently conspicuous to be seen by him after he has paced the several distances, so as to enable him, on turning round, to observe his distance from such point.

This having been accomplished, the instructor will form his detachment in rank at that end of the 200 yards at which the measuring was commenced, so that the measured line shall be perpendicular to the front of the detachment, one end being at the middle of the line. He will order four men of the detachment to go, one to 50 yards, another to 100 yards, another to 150 yards, and the other to 200 yards, and to front the company.

He should order on this service men of the ordinary height and size, who have no peculiarity of dress, nor any thing to attract particular attention. These men should carry their ordinary arms and equipments. The instructor should cause the men, placed in rank, to observe the various parts of each of the men, his dress, arms, and equipments, and point out to them that such of these, as are distinctly visible at 50 yards, are either not so clearly visible, or are reduced in apparent size, at 100 yards; that they are still less clearly visible, or more apparently reduced, at 150 yards; and so on.

He will then ask each man separately what are his observations on these several points, and will explain to him the effects produced to the eye by objects viewed at different distances; thus it is pointed out to him, that, at 50 yards the features of the man, the buttons on his jacket, the band and star on his foraging cap, can be plainly recognized, while at 100 yards the lineaments can no longer be discerned, the buttons seem to form a continuous line, the star is scarcely separable from the band, and at 150 yards the buttons are quite invisible, and the face looks like a whitish ball under the line of the cap.

It will be indispensable that he shall point out to the men, that in foggy or cloudy weather, objects having much less light falling on them, appear much more distant than they really are, and that in clear sunshiny days, being much more lighted, the details are much more easily visible, and the object appears nearer than it is in reality. In an avenue of trees, objects appear from the effects of perspective much more distant than they really are; and the absence or contiguity of other objects, and the effects of light and shade, may apparently increase or diminish the distance in many cases.

When the men shall have been sufficiently drilled in this estimation of distance, the instructor will change their position to some unmeasured ground, and send a soldier armed and equipped as before, and as near as may be of the same height and figure as one of the four men already employed, to some distance which shall be determined by desiring him to halt.

At this distance he is to turn and face the company; the instructor will then command the men in rank to observe the man so sent out, and to estimate his distance, bearing in mind the observations they have already made on the four men, placed previously at certain known distances.

Having done this, he will call each man separately out of the ranks, and, making him speak in a low tone of voice, he will question him as to the distance, and as to his reasons for the opinion that he has formed; and the instructor will make a note of the distance assigned by each soldier.

The instructor will then cause each man to pace the distance, and will take a note of each man's measurement, and he will finally verify the measurement by the chain.

After this verification, the instructor will read the statement of each of the men aloud, and will make such observations on them to the men generally, as will lead to a more just estimate of the distance on any future trial.

The instructor must repeat this exercise continually until the men can pretty accurately judge of all distances not exceeding 200 yards; taking for each exercise a different ground, having, if possible, a difference of surrounding objects and colours, and a different conformation. These drills should also take place in different states of the atmosphere; at various parts of the day, morning and evening, and with different effects of light and shade. They should also be made with the sun in front, and behind the men, and in other positions as regards the sun.

When the instructor shall consider that his men know how to estimate, with sufficient accuracy, the distances included within 200 yards, he will proceed to the estimation of distances between 200 yards and 400 yards. With this view, he will measure with the chain a distance of 400 yards, and mark on the measured line distances of 200, 250, 300, 350, and 400 yards. The detachment being in line, he will order five men to take up positions as before, at each of these distances, the first at 200 yards, the second at 250 yards, and so on, and then to face the line.

He will then go through the same course as he already did for the previous distances; but in this case, the measured point of 200 yards will be the term of comparison for the longer distances. When the men are sufficiently capable of thus judging of these greater distances by the five men so placed, the instructor will take the same means by sending only one man to some uncertain distance, at which he will be made to halt as before, and precisely the same means will be taken to perfect the men in judging of the longer distances up to 400 yards.

After 400 yards, the distances will no longer be marked by single men sent out to certain distances, but by detachments. The distances up to 900 or 1000 yards, will be measured in the first instance as before, and the observations will be made on the distances between 400 and 900 yards.

After having been sufficiently drilled in these distances by the detachment so placed, a party composed of a corporal, a bugleman or drummer, and two men fully equipped, will leave the company, and march to some uncertain distance, to be assigned by the instructor as before, by his commanding the party to halt after having passed the distance of 200 yards. The corporal will then place the three men in rank, about a yard asunder, facing the company, and resting on their arms; he will take his position at the right.

The instructor will then cause the exact distance to be measured. During the whole of this operation, the company will be made to face right about, so as to have their backs turned to the party sent forward.

The instructor will then require the officers and non-commissioned officers to compute the distance, each one separately. He will then ascertain from each (without being heard by the others) his computation, and will correct it by informing each of the actual distance.

The officers and non-commissioned officers will then, having made the men face right about, so as to see the party, question each man separately as to his computation of the distance, making each come separately out of the ranks, so as not to be heard by the others. If wrong, they will order him to reconsider the computation, and will note each man's computation on a paper.

So soon as the majority of the company shall have made a computation near the distance, the instructor will order the ground to be again measured before the men. At each distance of 10 yards beyond 200, a signal, to be agreed on, will be given by the bugleman or drummer to the company, and they will be allowed time to appreciate the distance, by observing the measuring party, at the distance at which such party shall then be found.

When this distance shall have been accurately measured, the corporal with his party will advance, and take up a more distant position, with the same precaution of not being seen by the company as before, and the same course of computation of this increased distance, and the same mode of drill will be gone through, as was done for the lesser distance; the men in this case being required to compute, not only the distance from the point first taken up, and the increased distance, but also the whole distance between the company and the increased distance.

These several exercises will be followed out, until the men are capable of accurately computing distances with promptitude,—simply by sight.

There are, however, methods of computing distances by instruments; but which will not in service be generally practicable.

The importance, therefore, of estimating distances by sight cannot be too much insisted on, nor can too much attention be paid to it.

The measuring distances by instruments, is founded on the principle that in proportion to the greater distance, the size of the object is relatively diminished. Thus experience has shown that at 325 yards, an object has an apparent size of about one-third only of its actual size;—at 435 yards, about one-quarter only;—at 545 yards, about one-fifth only. It may easily be understood then, that if we know the actual height of an object, we may, by comparing its apparent height at any distance unascertained with its real height, arrive at the knowledge of its distance.

Now, suppose we could determine the distance from us of an infantry, or cavalry soldier. The average actual height of an infantry soldier, with his chako, will be about six feet, and that of a mounted trooper, about eight feet; if we then can ascertain his apparent height, we shall, by comparing it with the known diminished height at any given distance, be enabled to ascertain his distance from us. Thus, for instance, we find that the apparent height of an infantry soldier, at some unascertained distance from us, is about two feet, and knowing that at 325 yards, the apparent height of an object is only the one-third of its actual height, and that the actual height of the soldier is six feet, we are enabled to conclude that his distance from us is about 325 yards.

For all practical purposes in Rifle firing this approximation is sufficiently near. We have then to arrive at some means of finding the apparent height of the soldier.

Now to this end, there are various means by the use of instruments, but as in practice it is necessary to adopt some easy mode, and very extreme precision is not requisite, a rough plan has been adopted of arriving at the desired conclusions.

A rule, having on each side marked the inches, from one inch to three or four feet, and on one side a scale of the distances corresponding to the apparent height of a horseman, and on the other, a similar scale, corresponding to the apparent height of an infantry soldier, is held in the right hand, at arm's length, and in a line with the right eye, and placed vertically or upright, so that the number of inches and the corresponding degree of the scale of distances may be read off. The observer's head being kept perfectly steady and the left eye closed, a sight will be taken, and the upper part of the rule will be applied to the top of the object; for instance, the chako of the infantry soldier; the thumb of the right hand will then be made to slide down the rule, until it comes to the point where another sight being taken, the thumb will appear to be on a level with his feet. The part of the rule between the top and the thumb will then indicate the apparent height of the soldier, and on the corresponding scale will be found the distance.

This is a rough mode of estimation, but will generally be found to be sufficiently accurate for all practical purposes, not exceeding 200 yards distance. This rule may easily be made by any one who may find it necessary.

But there is a more scientific apparatus, called a stadia, which being very simple and easy of application, is generally used.

This stadia consists of an isosceles triangle of the form shown in Fig. VIII., Plate 2,cut out of a piece of thin metal or a card. It will be observed that the interval between the two sides of the triangle diminishes gradually, from the base or bottom, to the summit or top. Taking this base to represent the apparent height of an infantry soldier, at a distance of 200 yards, the different intervals will represent his apparent height at greater distances. A space may therefore be found which will correspond with the apparent height of the soldier at any distance greater than 200 yards, whatever may be that distance. The base and the height of the triangle being chosen, so as not to render the divisions confused, and not inconveniently to multiply the degrees marked on the scale, it will be easy to determine on the triangle the intervals corresponding to certain apparent heights related to 200, 225, 230 yards, and so forth, and this will be sufficiently near for all practical purposes.

The distances are marked with strong or longer lines at 200, 300 yards, &c., and with lighter or shorter lines for intermediate distances, and numbers corresponding to the distances are marked against these lines.

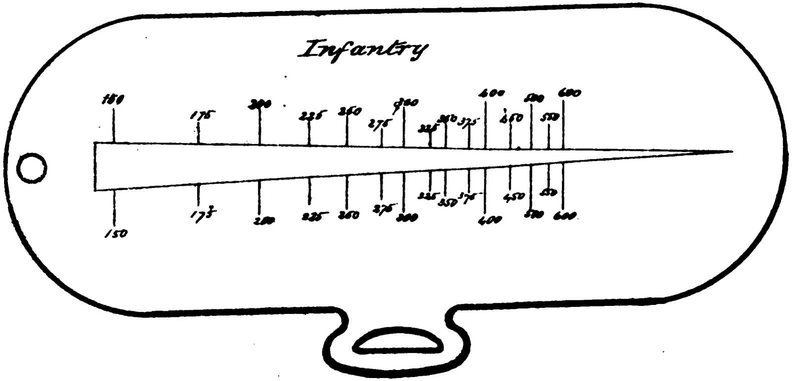
The same instrument may be used, but marked on the reverse side with a different scale, for a cavalry soldier.

When it is desired to use the stadia, to measure for instance the distance of a foot soldier, it is held between the thumb and the two first fingers of the right hand, the base or bottom is held exactly vertical or upright; the arm is held out quite extended in a line with the right eye; the head must be kept perfectly steady, and the left eye be closed. The soldier, whose distance is required, is observed through the triangle, the eye being first directed to bring his

Selections

Figures in Illustration of Extracts from the Soldiers' Manual of Rifle

Fig 8. Page 276.



Madras Artillery Depôt

H.J.K. lith.d

head and the top of the upper side of the triangle into one line, and then to bring his feet and the lower side of the triangle also into one, or the lower line, so that the soldier apparently fills the interval of the triangle exactly. The number to denote the corresponding distance is then read off. But if no degree of the scale be exactly opposite to this point, allowance will be made for the difference from the nearest distance

In using the stadia great care must be taken always to keep it at the same distance from the eye, and to keep the base exactly vertical or upright. Of course it is understood, that where a certain distance is indicated, as that at which the stadia should be held from the eye, this distance must be carefully observed.

In the appreciation of distances necessary for the instruction of troops, the officers and non-commissioned officers may use the stadia.

Beyond 500 yards, the indication of the stadia, from the minute differences in apparent height, cannot be accurately relied on.

In practice, therefore, either these distances must be judged of by estimate, or more perfect instruments, if necessary, must be employed.

Of this description of instrument there are two which have been brought under our notice.

One is the Lunette or Telescope of Messrs. Lerebours and Secretan,* and the other the Telescope or Teleometer of M. Porro, an officer of the Piedmontese Engineers in Italy.

The Lunette of Messrs. Lerebours and Secretan has micrometric wires stretched over the field of the Telescope, as shown in Fig. V, Plate 2.

At various distances marked with the letters *a*, *b*, *c*, *d* and *e*.

The space *a* corresponds to a distance of 200 French metres, or about 110 yards.

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* The eminent Opticians of the French Imperial Observatory and Marine, 13, Place du Pont Neuf, Paris.

The space *b* to about 220 yards.
,, ,, *c* ,, 330 ,,
,, ,, *d* ,, 440 ,,
,, ,, *e* ,, 550 ,,

When a soldier is included between the lines of the space *a*, he is at a distance of about 110 yards. When between the lines of space *b*, about 220 yards, and so on.

If the soldier should not fill more than half of one of these spaces, he is at double the distance indicated by such space. If the half of the height only of the soldier should be included between the lines of any space, he will be at half the distance indicated by such space.

The height of a soldier is here measured from the soles of his feet to the line of his eyes.

The Prismatic Micrometric Telescope or Teleometer of Monsieur Porro, derives its name of Teleometer, from two Greek words, signifying "a measurer of distances." By a happy adaptation of prisms, as reflectors, its length is reduced from the ordinary dimension to about the measure of the breadth of the hand (Fig. VII. Plate 2), so as to be easily portable, and it is set for any eye in a moment, by a small screw moved by the thumb.

Our limits will not allow us to describe particularly the optical arrangements of this instrument, which would lead us away from our present subject into too lengthened and too scientific details on the principles and effects of reflection; we must content ourselves by stating, that it may be used either as an ordinary telescope, or as a means of measuring the distance from the eye, of any object whose actual height is known. It is in this latter application that we shall now particularly consider the teleometer of M. Porro.

An apparatus is adapted to a small tube, which contains the focal glass, or that glass which is applied to the eye, consisting of wires stretched across this tube at various spaces, such as that shown in Fig. VI., Plate 2, *fig*. 1, *fig*. 2, *fig*. 3.

The Prismatic Teleometer, or Micrometric Telescope.

By the sub-divisions of the scale at the side, the whole, or a part only, of an object, whose total height is known, may be taken as a term of comparison in the estimation of distances. The object or part of the object selected must correspond exactly with one of the spaces, or in other words, be intercepted by two of the wires of the Teleometer.

The Micrometer is an apparatus applied to the focal glass of the Telescope; it consists of five wires placed across the disc of the Telescope, as shown in *figs.* 1, 2, 3, in which A B shows one space; C D a second; and E F a third space. A B shows the distance to be equal to 100 times the height of the object; C D 200 times; and E F 500 times.

***1st Example.*—If the lower wire of the space A B cuts or crosses the knees of a body of infantry, the other line the points of the bayonets, the scale on the left hand gives 200 yards distance.**

***2nd Example*—If one of the wires of the space C D touches the feet, the other the waistband of an infantry soldier, the scale would give 110 double yards, or 220 yards distance.**

***3rd Example.*—If one of the wires of the space E F cuts or crosses the horse's hoofs, the other the epaulettes of the cavalry soldier, the scale will give 250 times 5 yards, or 1,250 yards.**

These wires have three separate spaces, viz., A B, including the space occupied by three wires, or in other words, between the upper and lower wire; C D, the space between two wires,—the intermediate and lower wire; and E F, the space between two other wires, not so distant from each other as C D.

Now these spaces A B, C D, and E F, represent three distinct distances from the eye; the first, or A B, 100 times as great; the second, or C D, 200 times as great; and the third, or E F, 500 times as great, as the actual height of an object looked at through the teleometer.

On the diagram or plan, (Fig. VI. Plate 2,) a scale will be found applied to the actual heights of an infantry and a cavalry soldier. On the right hand are the figures 0, 1 ft. 6 in., 3 ft., 4 ft. 6 in., or scale of heights up to 9 ft. or 3 yards. Between these figures are lines running from the left to the right, or horizontally, dividing each yard into tenth parts, for the facility of calculation; by examining these figures and lines, the height of an infantry soldier is found to be given as about 6 feet or 2 yards, and that of a cavalry soldier and his horse, as about 8 feet.

On the left or opposite side of the scale, are figures ranging from 0 to 300. These figures denote the distance of the object, as measured by A B. The intervals between the figures on the scale are again subdivided into fifths, by the horizontal lines running from left to right.

Now it will be remembered that the space between the wires A B, (*fig. I.*) shows an object to be at a distance equal to 100 times its actual height, when the object is included between them; C D, 200 times; and E F, 500 times the actual height.

We will now show how this instrument is used to measure distances.

First example: Let the lower line of the space A B cut or cross the knees of an infantry soldier who is at a distance, and let the upper line cut or cross the point of his bayonet; on looking to the figures on the right of the scale, we find that the actual height of this part of the man with his bayonet, is 2 yards.

Now since the figures on the left indicate the distance, we find the space between 50, (the line of the knees on the scale,) and 250, (the line of the bayonet,) to be 200; and as the quantity is taken in yards, we find therefore the scale to indicate that the soldier is at 200 yards distance.

This scale, therefore, corresponds with the indications of A B, taken in another point of view.

We have seen that the space A B, has shown the height by the scale to be 2 yards, and as this space shows an object at 100 times the distance from the eye, we multiply 2 yards by 100, which gives us 200 yards, the actual distance of the object.

Again, as another example: Let us take the space E F, (*fig.* 3) and apply it to a cavalry soldier. We find that from the feet of the horse to the head of the rider, is included within E F. Now on the right hand of the scale we find that the actual height of him and his horse to this point, is 2½ yards; we therefore multiply 2½ yards by 500, and we find 1,250 yards to be the distance from the object.

This result is not shewn in figures on the left hand of the scale, which, to avoid confusion, is confined to the distances shown by A B, but it could be easy to add them for C D and E F, and they may be ascertained by multiplying the distances on the scale by 2 and 5 respectively.

It is most important that soldiers should be accustomed to judge of distances correctly; that they should know how far their Rifles will carry point-blank; and also the exact degree of elevation that is required, in order to hit objects at different distances beyond that point-blank range. They should therefore be trained to a knowledge of distances on every kind of ground, and be at all times prepared to answer correctly the following simple questions:—

Firstly, What is the point-blank range of your Rifle?

Secondly, Does it carry to the right or left?

Thirdly, How many yards are you distant from such an object?

Fourthly, What is the requisite degree of elevation in order to enable you to hit the body of a man at 200, 250, 300 yards, &c., and so on.

There is another essential point connected with distances, to which it is necessary to direct particular attention, which is the firing at an object in motion.

A foot soldier gets over in a minute at quick march about 72 yards, at the pace of a charge about 88 yards. A Horse walks over about 433 yards in 4½ minutes, trots over the same distance in about two minutes, and gallops over the same distance in about one minute.

A foot soldier occupies in rank a width of about 2 feet; a trooper about 3 feet.

Now suppose that a cavalry soldier be moving to or from the point of the line of vision, which is at point-blank range; it is clear that if the Rifle be fired to strike at point blank-range, the ball will either fall short of, or go beyond the cavalry soldier by the distance that will be passed by him, during the time taken in the flight of the ball. Allowance must therefore in such circumstances be made for this distance.

Suppose him to be coming nearer, in a direction perpendicular to the plane of projection, and to be at the point of point-blank range when aimed at.

Allowance must be made for his being somewhat nearer when the ball shall reach him, and an aim must be taken accordingly below the line of vision, or in other words, at the feet of the horse. By such means, as the ball rises in the trajectory, within point-blank range, the ball would strike the head of the horse or the rider.

Suppose on the other hand, the cavalry soldier be riding away in the same plane of projection, allowance must be made for his being more distant when the ball reaches him, and an aim must then be taken above the line of vision, or in other words, at the head of the cavalry soldier; and since, as the trajectory falls below the point-blank range after it has passed it, the ball would strike the body of the horse, or the rider, in such case.

Allowance must also be made in case of his moving to the right or to the left; but as in this case his distance would be nearly the same, it will only be necessary to direct the Rifle to the right or left, so as to compensate the probable distance in either of such directions that he may pass over.

In being engaged with an enemy, it will always be desirable in estimating the distance, to fire the first round rather before than beyond him, since this will lead to a more just appreciation of the distance than could be obtained by firing beyond him; besides which, there would be the chance that the fire would not be thrown away, since the ricochet or bound of the balls may do him as serious an injury as a fire directed exactly into his ranks.

The just appreciation of distance is, we repeat, of the highest importance. Well skilled in this, the soldier seldom throws away a shot, and this has a double effect,—the saving his ammunition, and the intimidating and destroying his enemy. The value of his ammunition can never be too highly estimated, since nothing inspires more confidence in him than that he has a cartouch box well provided against every emergency. One single charge of ammunition may be the means, under a variety of circumstances, of saving his life, or of turning the tide of victory in his favour. The effect, too, of a well directed fire on an enemy is not confined simply to his destruction, it distracts him, and throws him into disorder, and nothing makes so strong an impression on him, as the having his ranks thinned by every discharge, whilst on the other hand it tends to animate and encourage the troops who are opposed to the enemy, and opens to them the chances of victory; not only by the cutting up the enemy's ranks, but by introducing among them that fear of the skill and coolness of their opponents, which has a great moral influence in favour of the latter. Nothing, moreover, affords so favourable an opportunity for a successful charge, as the effects produced by a steady and well directed fire. On the other hand, a hasty and ill-directed fire, leads an enemy to hold his opponents in contempt, and creates in him such confidence, as once felt, seldom quits him during the combat.

CHAPTER V.

Causes of deviation in the firing, and their remedies.

There are several causes which may produce a failure, or imperfection in firing.

First. Because of ignorance of the principles of firing, and the necessary management of the Rifle.

Secondly. Because the ball may, and generally does, suffer deviations from the leaving the Rifle in its passage through the air.

The first class of causes may be materially, if not wholly obviated, by the attention given to the instructor, and practice of the men.

The second class of causes depends on the quality of the Rifle, and on exterior influences operating on the ball. The most expert marksmen, and most skillful shot, cannot obviate some of these causes,

The principles we have laid down, as to taking aim, must be applied with reference to these causes.

The Rifles are not always of the same make, nor is the make, always regular and perfect, as we have been compelled to assume it to be, in laying down general principles.

Sometimes, for instance, the line of vision of the Rifle itself is not exactly in the same plane with the axis of the barrel. It happens, therefore, that an aim taken with the sight and back sight, would not carry the ball in the plane of the true line of vision. In this case, therefore, the defect in the Rifle being ascertained, aim must be taken to the right or left, according as the true line of vision is to the right or left of the plane of projection of the Rifle. The distance to be taken to the right or left, must depend on the imperfection of the Rifle, and on the distance of the object, a corresponding greater allowance being made for a corresponding greater distance. This, however, is an imperfection that will not generally be found in the Rifle to any great extent.

Not only may this defect of the Rifle, in popular language, carrying to the right or to the left, exist, but the sights may be found not accurately to correspond with the distances marked. This is a much more common defect, and one very difficult to be avoided. If it depended simply on the imperfection of the sight and back sights, it might be corrected without much difficulty, but its principal cause is the difference in the calibre, or bore of the Rifle, which, though in some cases being almost inappreciable, still exercises very considerable influence, and would require that the sights of each Rifle should be mathematically adjusted to suit the calibre or bore.

Every soldier must, therefore, observe very carefully the effects produced by his Rifle, and make a compensation accordingly.

Another cause of deviation in the length of the range, will be found in the difference of cartridges; since with what care soever they may be manufactured, differences will exist when made on a large scale, either in the quality or quantity of the powder, or in other respects.

Another cause of deviation, is the Rifle being held not in the plane of the line of vision, but inclined to the right or to the left; these effects are the more apparent as the inclination is greater, and the distance of the object is increased: and, therefore, the greater the distance of the object, the greater the necessity of avoiding this cause of deviation.

Another cause of deviation, and which we must again press on our hearers, is the change of direction occasioned by pulling the trigger, especially if it pull hard. To obviate this, we must again propose the necessity of constant practice.

Of the causes of deviation arising from external influences, may be noticed,—the wind, the temperature, and the humidity or dampness, and density of the atmosphere; the position of the sun, and the difference of level between the object and the Rifle.

First. The wind.

When the wind is opposite to the direction of the ball, the ball finds a greater resistance than in a calm atmosphere, and is proportionally lowered.

When the wind is in the same direction as the ball, it increases the velocity of the ball, and the ball is raised in the plane of projection.

When the wind forms an angle with the line of the ball, or in common language, blows from either side, the ball is carried to the side opposite to the wind; and the more so, as the wind is at right angles, and as the force of the wind is great, and as in the other cases already mentioned, the greater the distance of the object the greater the deviation.

Secondly. The temperature, humidity or dampness, and density of the atmosphere.

These have an effect on the ball, and occasion deviations in its course. When the temperature is high, the density of the atmosphere is generally less, and the ball will rise, but still in the plane of projection; a contrary effect takes place at low temperatures, attended with increased density, or with humidity of the atmosphere. Generally in dry weather, the range is somewhat longer.

Thirdly. The position of the sun will materially operate, by deceiving the soldier as to the real place of the points, which determine the line of vision.

When the sun is to the right, the right part of the sight is lighted, while the left is in shadow; a bright spot is also seen on the right side of the sight, which will attract the attention of the man, and which will lead him to think the middle of the sight nearer to the right than it really is; a contrary effect is produced when the sun is on the left side. The soldier is thus led to direct the line of vision out of the direct line.

This error is to be avoided by directing the aim a little to the right, when the sun is on the right side; and a little to the left, when the sun is on the left side.

Fourthly. In giving rules for firing in our former Lectures, we have supposed the line of vision to be horizontal, or deviating but little from a horizontal line.

When the positions of the object, and the party firing, are not in the same level, the form of the trajectory changes; and if, in such case, the usual rules are followed scrupulously, the object will not be struck.

When the line of vision is above the horizon, the trajectory is less curved, and when below the horizon, it is more curved.

When an object, therefore, is placed on an elevation, aim must be taken above the object, and when it is on ground lower than the horizon, aim must be taken below it.

The foulness of the Rifle is also another cause of deviation.

The heating a Rifle, by long continued firing, also creates deviation. As the Rifle becomes more heated, the ball will have a tendency to rise, and for this, allowance must be made.

The injury to the cartridges from having been a long time in the cartridge pouch; from their being shaken and injured on a long march; from the powder becoming damp from the humidity of the atmosphere, rain, or other cause, are also reasons of deviation, which must be particularly atttended to.

In wet weather, the soldier must be very careful to prevent the rain getting into the barrel, lock, or nipple of his Rifle, which would have a material effect in causing a deviation, if not of wholly rendering useless his Rifle.

CHAPTER VI.

General Observations.

Haste and precipitancy are frequently productive of ill results; yet in few situations may they be more so, than in a field of battle. Rapid firing, combined with skill, may be sometimes useful and even necessary; but rapidity without skill is worse, infinitely worse than useless. It is mischievous, nay dangerous; mischievous, in that it does not harm an enemy, and gives him confidence by creating a contempt for his opponents, while it begets a corresponding want of confidence in one's comrades;—and dangerous, in that it uselessly expends that ammunition, the due economy of which should be one of a soldier's first cares, and deprives him of it without cause, when it might have been husbanded for a juncture, in which the having it might save the soldier's life. The soldier should have this truth impressed firmly on his mind, *that it* *is better to fire one shot with effect in ten minutes, than to fire ten ineffectual shots in one minute.* It does more execution, and does not waste ammunition.

The fire of the infantry must have, in all future warfare, an immense influence in the fate of battles, and it is to the rendering this as perfect as may be, that our present efforts are directed.

To instruct a man who has passed some twenty years of his life unaccustomed to the use of fire-arms, is doubtless a difficulty; but a difficulty that, with adequate information and zealous practice, may be so surmounted as to make him nearly as efficient as any of the men of whose prowess some extraordinary facts are extant.

We are of opinion that the firing with ball is by no means essential in practice, to the making an expert marksman, and it is with this conviction that we would press on instructors, on the one hand, to devote most of their attention to the preliminary exercises recommended in our first chapter, of practising aiming, and the management of the Rifle in firing, including particularly the steadily pulling the trigger, so as not thereby to change the position of the Rifle; and, on the other hand, would press on recruits, to submit patiently and cheerfully to such preliminary exercises, as a certain means of making them skilful shots, and thus affording them the many great advantages which result.

In the firing with ball, it is almost wholly impossible to make the necessary corrections in the position of the Rifle, the correctness of aim, the proper elevation, the steadiness of the Rifle, or the mode of pulling the trigger; all essential to a good marksman, and innaccuracy in any one of which, will cause ammunition to be thrown away. Errors may exist in all these, and yet at the moment of firing, hazard may direct the ball to the bull's eye, whereas if due attention be paid to, and sufficient practice be had in, these preliminary exercises, under careful inspection and correction, the shot will never be one of hazard, but will always be certain, as the result of skill.

The effect on the recruit too, of allowing him to fire ball before he has acquired sufficient dexterity to be assured of his mark, will tend to make him a sort of chance shot. He fires, and his ball has gone to the left; he tries again, the same causes produce similar effects. He now finds his ball has gone to the right; he fires too high, and to remedy this, he now fires too low. He is quite bewildered, and at length comes to the conclusion that his Rifle is faulty, or discovers some other cause, but not that it is want of skill, arising, in great measure, from his having been made to fire ball at a mark, without having had the necessary preliminary instruction and practice, to fit him for certainty and success. The result of all this is, that every soldier fires after his own fashion, and that, without the possibility of any other correction from those who superintend him, than simply that his ball has failed in this or that manner.

There is another point, and that, too, of no little importance in adopting principally these preliminary exercises,—they are attended with no expenditure of ammunition, and may consequently be used every day, while ball firing, from its cost, can only be occasionally resorted to, so that the soldier may have a hundred days' practice in the one, for one day's practice in the other. Of the consequence there can be little doubt.

In these preliminary exercises, the end of which is to make the men expert shots, it may be as well, so far as possible, for the superintending officer or instructor to avoid giving the word of command; since the soldier, accustomed to discipline and prompt obedience, may frequently pay more attention to the immediate execution of the command, than to correct aiming, or the management of his Rifle in firing.

While on the subject of these preliminary exercises, it may be well—by way of impressing on the minds of the instructor and soldier, a point of very high importance, the pulling the trigger so as not to cause any change in the position of the

Rifle—to recur to that subject, and notice it a little more in detail, than we found it necessary to do in our first chapter.

It is not difficult to keep the Rifle steady in the direction of the object aimed at, so long as there is no motion in pulling the trigger; but this movement creates at once a difficulty. The pressure on the trigger throws the Rifle generally to the right, especially if the spring of the lock be hard. As some means of compensating this, aim should in most cases be taken, therefore, rather to the left than to the right part of an object.

This, however, is not all that is requisite. The man must carefully keep his Rifle to the aim, during all the time that he is pulling the trigger, and he must pull the trigger by a steady and continued pressure of the finger, without the slightest jerk or irregularity, and so, that he may be almost unaware of the identical moment at which the Rifle will go off; and during the whole of this time he must suspend or stop his breathing. The trigger, it will be remembered, is to be pulled with the second joint of the first finger, and as this is a matter of the very greatest importance, it may be as well for the instructor himself particularly to show each man separately the manner in which this is to be done.

The men, after having pulled the trigger, should still continue to hold the Rifle in the line of aim, and observe whether it has changed its position. And the whole of this exercise should be repeated until they have attained a perfect steadiness in position before, during, and after the fire.

In taking aim, the left eye being shut, the right eye is to be fixed stedfastly on the object, or rather on that part of it to which the aim should be particularly directed; and the Rifle should be raised gradually until it is accurately in line. Experience has shown, that to *strike an object it is necessary to see it distinctly at the moment of firing.*

There are certain particular rules with reference to taking aim, that we have reserved for this place.

When an object of a certain size is fired at, at point blank range, the centre of the object is the point to be aimed at, for if any of the extremities be taken, there will be greater chance of missing it, by a deviation of the ball, or by inaccuracy of aim.

If aim on either side the centre be taken, it would always be preferable that it should be rather to the left than to the right, to compensate, as was just now observed, for any change of position caused by pulling the trigger.

The first fixed sight on the Rifle is for distances of 200 yards, and the second fixed sight for 400 yards.

If the object be at less than 300 or 400 yards, the lower part of it must be aimed at, because, as we have shewn in our first Chapter, the trajectory (as seen in Figs. I, II, III,) rises above the line of vision, for all points within the point-blank range.

If the object be exactly at 200 or 400 yards, the centre of the object must be aimed at, because the trajectory cuts or directly meets the line of vision at point-blank range. If the object be beyond 200 or 400 yards, the upper part of the object must be aimed at, because beyond the point-blank range, the trajectory falls below the line of vision.

This rule, of course, has reference to distances within about twenty-five or thirty yards, on either side of point-blank range; since, if the distance be greater, a corresponding allowance of elevation or depression in the aim must be made.

For distances beyond 400 yards, the moveable bar or slide of the sight may be adapted, very nearly to the actual distance; but it must be borne in mind, that at all intermediate distances at which the moveable slide will not exactly indicate the distance, allowance must be made for the difference, by elevating or raising the aim, if the object be beyond point-blank range, and by depressing or lowering the aim, if it be at less than point-blank range.

All this will be readily seen and understood by looking at the diagram or plan (Fig. II.) of the line of vision and the trajectory.

To illustrate these rules practically, it would be well to have a series of targets (as in Fig. IV.) placed at stated distances in the same horizontal line, the bull's eyes being all placed also in a horizontal line, by which means the soldier may be shown the effect of every shot.

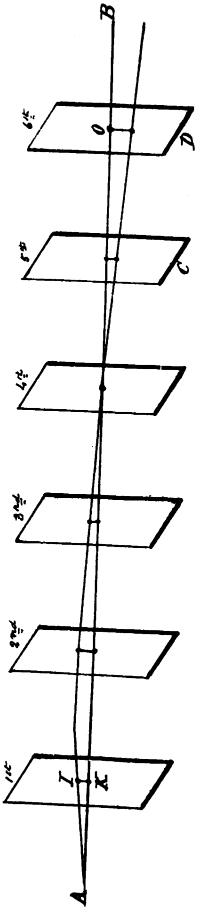

Fig. 4.

These targets may be numbered from 1 to 6. The target No. 4, should be placed exactly at point-blank range, and the other targets, being at certain known distances, say at ten yards apart, the target No. 1 would be thirty yards before or within the point-blank range, and the target No. 6, twenty yards behind or without the point-blank range. The soldier may then be directed so to adjust his aim, that his ball shall strike an object at thirty, twenty, or ten yards within point-blank range, at point-blank range, or at ten or twenty yards without, or beyond point-blank range. The target No. 4, not being seen by him, it is clear that he cannot by firing at the object which is exactly at point-blank range, attain as a necessary consequence the trajectory in the other targets, and he will therefore be compelled to adjust his aim so as to strike the object he is required to do.

The position of these targets may be varied from time to time, so as to show the trajectory in any required relation to the point-blank range, and thus may the soldier be taught practically, and pretty correctly, the curve of the trajectory,—both within, or before—and without, or beyond point blank range; a knowledge of great importance to him, especially when firing at an object in motion.

We now come to another point. There are several positions that may be taken by the soldier in firing:—

First. An upright or standing position.

Secondly. On his knee.

Thirdly. Lying down in any position.

Little need be said on the first position, since the exercises will be principally in this position, and attention to the rules we have already prescribed will render the soldier sufficiently competent in this.

As to the second, the position on the knee, much difference of opinion exists as to its advantage, among very competent authorities; some of them considering it generally to be avoided, as much as may be, from its not being military; from its affecting the accuracy of the fire; and from the loss of time occasioned in loading, from the necessity of rising to an upright position for loading, and returning again to the same position for firing. It has therefore been recommended that in practice it should be used but seldom.

On this point, we would, however, bring under the reader's notice, and submit to the consideration of instructors, the remarks made by a very high French authority in an elaborate work on firing with portable arms. He says:

" It is incontestible that when the soldier is in some sort " left to himself, when he is out of the ranks, in a word, " when employed as a sharp-shooter, that his skill, as a " marksman, produces its best effect. Ought he in such situation to be compelled to take this or that position? Cer- " tainly not! The man places himself as he finds best, and " takes the position most convenient to him. For the great " majority of men, the position on the knee is preferable, as " to steadiness and firmness, to the upright position; it al- " lows him to aim more certainly, and fatigues the left arm

" much less, by the support afforded to the elbow by the " knee, and is almost sure to produce shots of more effect. " A well-practised soldier will easily take and quit this position; besides, it has this advantage, that it only exposes " half the surface to the fire of an enemy. It cannot be " termed unmilitary, since the front rank is frequently obliged to take this position.

" We are therefore far from thinking that this position " should be exceptional; we think it should be particularly " attended to, and more especially where men are likely to " be employed in detached bodies, or singly; and we are " quite sure that we have with us the opinion of all the officers who are generally employed as instructors in firing, " when we say that it is the position *par excellence* for every " man whom it is desired to make a finished marksman."

The third class of positions requires from us no particular notice here.

We have, throughout this treatise, used the term " Rifle," and some portion of it has particular and exclusive reference to that weapon. We have confined ourselves to this term, " Rifle," to avoid unnecessary repetition and confusion; but, as will readily be understood by the intelligent reader, the greater part of our Essay will equally apply to the Musket, or any other portable fire-arm, that may be employed. There is, however, one cause of deviation in the musket, which does not exist in the Rifle. For the musket, the ball is cast somewhat smaller than the bore, and leaves, therefore, a space between its surface and the barrel, when it is rammed down. This space is called " windage." Now, if the ball be not, as it very seldom is, placed exactly in the centre of the barrel, the powder exploding in this windage, as well as below the ball, occasions a deviation in the ball, and not only so, but makes sometimes a marked difference in the range.

On this, and many other accounts,, it is impossible to fire with a musket, with the same precision as a Rifle. Much, however, of this difference, may be compensated by care being taken in the loading.

The principal difference between the Rifle and the infantry musket, lies in the difference between the ranges. Experience has shown that the point-blank range of the musket is about 100 yards.

In the same manner as in the case of the Rifle, the trajectory rises above the line of vision, within, or short of this range, and falls below it, without, or beyond the point-blank range.

In order, therefore, to strike an object at less than 100 yards, the aim must be taken below the line of vision. At 100 yards, it must be taken at the object; and above 100 yards, the aim must be taken above the object, in the proportion in which the trajectory lies above or below the line of vision.

To reduce this to practical rule, we will suppose the object to be struck, to be an infantry soldier:—

At 125 yards and any shorter distance near to it, aim at the centre of the soldier.

At 150 yards aim at his breast.

At 175 yards aim at his head.

At 200 yards aim at the top of the chako.

Beyond 200 yards, there is no point within the limits of the man at which aim can be taken with a common musket.

Suppose again, that the object to be struck is a cavalry soldier.

At 125 yards, or a little less, aim must be taken, with the musket, at the horse's chest.

At 150 yards, at his head.

At 175 yards, at the breast of the rider.

At 200 yards, at the rider's head.

At 225 yards, at the top of his helmet.

There is one other point to which we must advert, and which, though apparently of minor importance, may yet have important effects in retarding the progress of some of the younger recruits, and this is the recoil, or kick of the firelock. This may arise, either from an excessive charge, or from the piece not being held firmly pressed to the shoulder, at the moment of firing.

The latter cause is the only probable one in the army, since the cartridges are all adapted as a proper charge to the Rifle or musket. The remedy, therefore, for the recoil, or kick, lies with the soldier himself; and, independently of avoiding all recoil, the holding firmly the musket to the shoulder has another essential advantage, the tending to keep steady the musket in firing.

Sometimes, with every care and precaution, a musket may miss fire. In this case it should still be held to the shoulder, until all chance of its going off has ceased; since, not unfrequently, it may hang fire for several seconds, and if removed too soon, might cause an accident to the man or his comrades. A skilful and steady shot may always be recognized by his attention to this precaution.

If a musket should miss fire, care should also be taken in pricking or cleaning the nipple, to direct the muzzle away from any one, as it often happens that a portion of the percussion powder is left on the nipple, and will, by friction in cleaning, cause the charge to explode.

Such are the general directions, within the limits of which will be found what is essential for a soldier to observe in this branch of his duty. We may add to this, that if it should be his fortune to be called into the field to meet his country's foes, great care must be taken by him in firing, that it be not hurried, and that he present deliberately; bring up his firelock gradually; and look steadfastly at his object before he fires,—otherwise his fire will lose all its effect upon the enemy. The value of his ammunition must be highly estimated by him, and the most extreme jealousy of its expenditure must be entertained. In proportion as a cool and well directed fire serves to distract and throw an enemy into disorder, so a wild, confused, and hurried fire (which is always without effect,) is calculated to give him confidence, and a contempt for his opponent. It is impossible therefore to labour too much to give to soldiers the habit of steady, cool, and effective firing.

Extracts from an Elementary Treatise on Strategy.

CHAPTER I.

DEFINITIONS.

DEFINITION 1.—The Science of War is that science which presides over and directs all military operations and combinations.

DEF. 2.—Strategy is that division of the science of war which superintends the direction of all operations, and the construction of all combinations, except during the intervals of action; the instant at which the opposing forces, of whatever magnitude, come in sight of one another being in all cases (whether the affair be a battle, attack of post, siege, or of whatever kind) the signal for strategy to leave its presidency, and the last shot fired that for its return.

DEF. 3.—Tactics is that division of the science of war which presides over military operations during the intervals of action, defined in the preceding definition.

DEF. 4.—*The Base of Operations of an army is a strip of ground which satisfies the following conditions :—**

1. *Its length is much greater than its breadth.*
2. *The breadth may in general be taken to be thirty miles.*
3. *It may be straight or bent in any form.*
4. *It is furnished with fortresses and magazines, from which the army draws all its resources, ammunition, food, and reinforcements of all kinds.*
5. *Its boundary towards the enemy is a line of natural and artificial obstacles, forming a strong line of defence,*

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* This definition of a base of operations is too restricted. A single seaport town may be a base of operations as well as a line of country.

(Signed.) W. NAPIER,
Lieutenant General.

and is in general formed by a chain of mountains, a large river, or mountains and rivers conjointly.

6. *At the commencement of a war, it naturally follows a strong line of natural obstacles on or near the frontier.*

As examples, let us take two of those in the accompanying maps, which have actually been bases of operation. The former of these has a river for boundary, the latter a chain of mountains.

Example.—The country bounded on the east by the Rhine, from Bale to Mayence, and extending 30 miles' distance from the river, towards France, has been a base of operations for French armies operating against Austria. The length of this base is about 160 miles, and would be sufficiently fortified as a base of operations, if it had three large places such as Strasbourg, placed according to the rules given in the chapter on the application of the principles of strategy to the determination of the best system of fortresses for the defence of a country.

Ex.—Buonaparte's base of operations, at the commencement of his first Italian campaign, was the piece of ground between Montenotte, Savonne, and the Col-de-Tende, bounded towards the enemy by the mountains from Montenotte to the Col-de-Tende. The length of this base is 64 miles.

As a victorious army advances it is necessary to form successive bases of operations. The first base is called the primary, or original base; and the others the second, third, &c., bases of operation.

Ex.—Buonaparte's second base in the first Italian campaign was bounded towards the enemy by the Adige, from Trente to the sea; and had for its fortresses Verona, Legnago, and Mantoue. This transitory base is at a distance of about 187 miles from the original, measuring from their centres. It is necessary to state, from the comprehension of this measurement, that the original base (already given as an example,) which was at first bounded by the mountains between the

Col-de-Tende and Montenotte, had, by the surrender of the fortresses of Suze, Exiles, Fenestrelles, &c., increased its boundary to the line of mountains from Gênes, or Genoa, to Mount Cenis.

DEF. 5.—*The Theatre of War is the whole area of ground which it is necessary to take into consideration at any time during a campaign, in order to construct correctly a strategical combination.*

It is, perhaps, as well to guard the reader against confounding the scientific or technical signification of the term Theatre of War, now given, with the sense popularly attached to it by historians. The popular historic signification of the term is, the whole area of ground over which a war, when finished, has extended. The inutility of the popular signification to a military man is evident.

It is clear, that the thing signified by the term theatre of war, changes from time to time during a campaign, and may, at the commencement of a campaign, be a very different area of ground from that signified by the same term towards the conclusion.

Ex. 1.—Napoleon's theatre of war at the commencement of the Jena campaign (that is, the whole area of ground which it was necessary for him to take into consideration in constructing the first combination for the campaign) was bounded on the north by the North Sea, Denmark and the Baltic; on the south by the northern boundary of the Austrian Empire, and an imaginary line drawn from Nuremberg to Philipsbourg; on the west by the Rhine; and on the east by the Oder and Neisse.

Napoleon's rapid advance in this same campaign soon threw back the eastern boundary of his theatre of war with Prussia, till it became the extreme eastern boundary of that Kingdom.

Buonaparte's theatre of war at the commencement of the first Italian campaign, when based on the mountains from

Montenotte to the Col-de-Tende, was very different from his theatre of war towards the conclusion of the same campaign, when based on the Adige. The historian, using the term in his sense, may say, that a line 400 miles in length may be drawn through the theatre of Buonaparte's first campaign in Italy, from the Col-de-Tende to Leoben.

Ex. 2.—Napoleon's theatre of war at the commencement of the Austerlitz campaign was bounded on the north by the Mayn and the northern boundary of the Austrian Empire; south, by the Gulf of Genoa, Romania, the Adriatic, and Illyria; east, by a line drawn north and south through Presbourg; west, by the Rhine and western boundary of Piedmont.

DEF. 6.—*Those points whose possession conduces in an especial degree to the possession of the communications or roads on the theatre of war, are called Decisive Strategical Points.**

Decisive strategical points are more or less decisive according to the number and importance of the roads or communications of which they confer the possession.

It is to be observed, that the configuration of the theatre of war may be such that, on applying the principles of strategy to the construction of a combination, it may become apparent that a small road, insignificant as a commercial and general communication, is one of the most important military communications in the theatre of war. This importance arises from the fact, that on applying the principles of strategy to the configuration of the theatre of war, it not unfrequently happens that a combination presents itself, which possesses marked and decided advantages over all others, provided certain small roads exist, traversing the country in a good direction. Some small roads may in this way attain to a greater military importance than that possessed by the largest and most frequented roads.

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* This definition of Decisive Strategical Points is too restricted. A point may be seized which has none of the advantages of intersections of roads and junctions of rivers, and yet furnish the means of separating an enemy's forces, and compelling him to retreat or to accept battle disadvantageously.

(Signed.) W. NAPIER,
Lieutenant General.

It follows, then, that a point conferring possession of one of such small roads, may be one of the most important decisive strategical points in a theatre of war, or in a country.

It is also true that a point, which, when considered only as a means to the possession of the communication, is of a low order as a decisive point, may, from the disposition of the opposing forces, have its importance increased for a portion of a particular campaign to equality with a point which is in general more decisive.

Decisive strategical points are divided into Natural and Artificial, distinguished by the non-possession and possession of permanent fortifications. Among the latter are included points having entrenched camps, such as that of Drissa.

The decisive strategical points in a theatre of war are divided into the following classes:—

Class 1.—*Points which are at the same time at the junction of two great rivers, at the cross of two valleys, and at the intersection of several great roads.*

Ex.—Ulm (Map 1), at the junction of the Danube and Iller, at the cross of their valleys, and at the intersection of seven roads, of which five are great roads.

Lyon, at the junction of the Rhone, and Saone, at the cross of their valleys, and at the intersection of seven roads.

Kustrim (Map 2), in Prussia, at the junction of the Oder and Warthe, and at the intersection of six roads.

Mayence (Map 2), at the junction of the Rhine and Mayn, at the cross of their valleys, and at the intersection of eight roads.

It may be remarked that the possession of the point of junction of two rivers secured that of two têtes-de-pont.

Class 2.—Points which are at the intersection of a great river and many great roads.

Ex.—Dresden (Map 2), on the Elbe, and at the intersection of twelve roads.

Madgeburg (Map 2), on the Elbe, and at the intersection of nine roads, of which eight are great communications.

Plaisance(Map 1),on thePo,at the intersection of fourroads.

Class 3.—Points which are at the intersection of many roads.

Ex.—Leipsig (Map 2), at the intersection of eight great roads.

Nuremberg (Map 2), at the intersection of six great roads.

Milan (Map 1), at the intersection of nine great roads.

These three classes are, the number and importance of roads being equal, distinguished by the possession of 2, 1, and 0 tête-de-pont.

Class 4.—Points on roads which traverse a chain of mountains supposed inaccessible, except by a few roads; and points which in a mountainous country close passes.

Ex.—Bard, on the Dorea; Exiles, in the Maritime Alps.

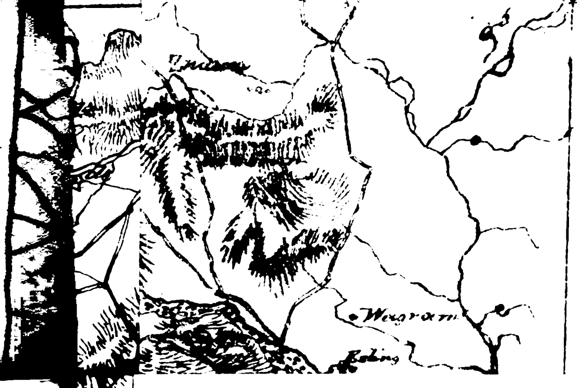
Class 5.—Points which block up the few valleys by which alone it is possible for an army to debouch after having passed a long natural barrier (whether a frontier or otherwise), accessible on a few points only.

Ex.—Ivrea, Sure, Fenestrelles, Pignerol, Coni, blocking up the valleys of the Maritime Alps from Mount Blanc to the Col-de-Tende.

Class 6.—Points well chosen on a road which traverses a difficult country.

Ex.—Girone and Hostalrie on the road from Perpignan to Barcelona, through the difficult country about the Pyrenees.

Class 7.—Points blocking up, or at least rendering very difficult, those roads, the possession of and free communication by which is necessary to the carrying out the most remarkable combinations which the principles of strategy and the configuration of the ground indicate, in the event of a war, to any one of the neighbouring states, of sufficient magnitude to be taken into consideration.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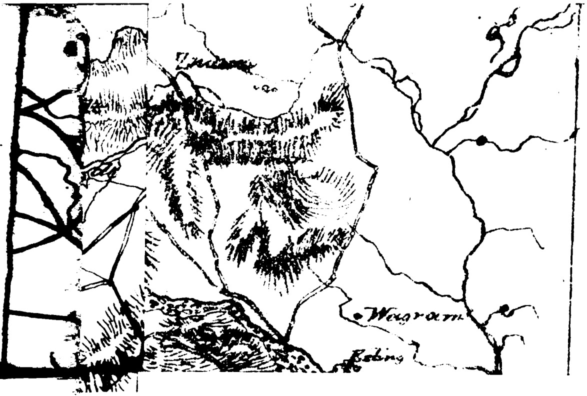
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Before leaving the subject of decisive strategical points: a point is of a higher or lower order according as the communications of which it gives possession are more or less important, the importance of any communication depending not only on its magnitude, but on the relative positions of the armies.

A decisive strategical point which closes one's own communications and opens roads leading on to the enemy's communications, will be in all cases one of a high order.

As examples of artificial decisive strategical points:—

The lines of Torres Vedras, Clarfayt's entrenched camp at Jemmapes, the camp of Drissa, any fortress in masonry.

Def. 7.—*A Base of Manœuvres may be defined as a miniature base of operations constructed close to the actual seat of the war for the time being. It is occupied only till the manœuvres of which it is to be the base are finished, and ceases to be a base so soon as the actual scene of manœuvres is removed from its immediate vicinity. It has, like a base of operations, its defensive line of natural and artificial obstacles, and has towns or fortresses on it. The occupation of a base of manœuvres, whenever it does take place, takes place after arriving from a base of operations in that part of the theatre where the war is to be, and before the manœuvres which are to bring about the collisions. A base of manœuvres contains in general one or more important decisive strategical points.*

Ex.—Napoleon used the line of the Danube from Dillingen to Ingoldstadt as a base of manœuvres at the commencement of the Austerlitz campaign, after arriving from his base of operations on the Rhine, and before proceeding to the manœuvres so celebrated under the name of the "Operations about Ulm." Donauvert and Ingoldstadt are the two most important decisive strategical points.

Ex.—Line of Elbe from Konigstein to Torgau, in Dresden campaign.

Def. 8.—*A road which is selected from among others as* *that by which one or more columns of an army are to march is defined to be a Strategical Line.*

Obs.—Every road is not a strategical line, though every road is capable of becoming one; it is the selection of a road from among others for the transit of troops that makes it a strategical line.

Strategical lines are divided into two kinds, the first called simply Strategical Lines, the second, Strategical Lines of Manœuvres.

DEF. 9.—*A cluster of decisive strategical points which form the place of rendezvous or assemblement for the different corps-d' armées before proceeding to manœuvres which have as their immediate object the bringing about of collisions, is generally called a decisive strategical point; but as the calling two different things by the same name induces confusion, such a cluster of points will be called a Place or Area of Decisive Strategical Assemblement.*

Obs.—Tho decisiveness of a place of assemblement will depend on the importance of the points of which it is composed.

DEF. 10.—*Those strategical lines by which an army marches from a base of manœuvres, or a place of decisive strategical assemblement, for the sole object of bringing about a collision between the two armies or portions of the two armies, are called Strategical Lines of Manœuvres. All others are called simply Strategical Lines.*

Ex.—The Strategical lines by which Napoleon directed his corps-d'armées towards the line of the Danube from Dillingen to Ingoldstadt, which was his primary objective, were as follows:—(The times of leaving the Rhine and one or two other particulars, which may appear discursive, are given, because reference will be made to these lines in a future chapter.)

Ney—passes the Rhine at Carlsruhe, September 26th, and goes by Pforzheim, Weiblingen, Gemund, and Dillingen to Donauvert (Maps 1, 2.)

Lannes—with his corps, and Murat with the reserves of cavalry, pass the Rhine at Kehl, and proceed to Dillingen by the direct road.

Soult—passes the Rhine at Spire, Sept. 26th, and goes by Heilbron, Pforzheim, and Weiblingen, to Donauvert.

Davoust—passes at Manheim, Sept. 26th, and goes by the direct road to Neubourg, a town on the Danube, near Ingoldstadt.

Marmont—crosses at Mayence, Sept. 22nd, takes the high road to Wurtzbourg, and thence by Anspach to Neubourg.

Bernadotte—with his corps and an army of 25,000 Bavarians (the Elector having entered into alliance) meets Marmont at Wurtzbourg, proceeds with him past Anspach to Eighstedt, a place near Neubourg, then, turning to the left, goes to Ingoldstadt.

Augereau—crosses at New Brisach, and proceeds by the grand route to menace the country between the high Danube and the Rhine.

Ex.—The place or area of decisive strategical assemblement at which Napoleon collected his corps-d' armées in the Jena campaign before proceeding to the manœuvres for bringing about collisions, was that included between Cobourg, Bamberg, Bareith, and Culmbach, having these four towns as its decisive strategical points (Map 2). The corps were, Davoust Lannes, Ney, Soult. Reserves of cavalry, Murat: guard, Lefebre.

Ex.—The strategical lines of manœuvres by which the army left the place of assemblement, mentioned in the preceding example, were (Map 2)—

Road from Bareith by Hof to Plauen,

Road from Bamberg by Cronach to Saalburg.

Road from Bamberg by Cobourg and Graffenthal to Saalfield.

Obs.—Armies, as a rule, always march on roads. The exceptions to this rule are very rare. Buonaparte crossed the St. Bernard, and Moreau traversed the Val-d' Enfer; but in the latter case there was a species of path, and the distance was very inconsiderable, not five miles. It may be considered as a general rule that armies keep the roads except before and after a battle; as, for instance, the Prussians, after the disaster of Jena, retreated across country from Apolda towards Buttelstedt. Hence, the position and direction of the roads of a country may exercise a very injurious influence, or facilitate greatly a strategical combination. The configuration of the roads is among the data from a consideration of which the combinations of a campaign are made, and thus influence the operations of armies. As well, a combination which is decided on as the best from a consideration of all the data, may be very much facilitated or retarded by a good or bad configuration of the roads by which it is to be carried into effect. We find Napoleon constructing high roads, whose position and direction were determined by the principles of strategy; an example which the Austrian government followed, and in particular made an excellent strategical road for operating on Italy.

DEF. 11.—*A Line of operation is the area of ground including all the strategical lines by which an army marches to a base of manœuvres, a place of assemblement, or a decisive point: should, however, these strategical lines lie in clusters, then the area of ground, including any set, is itself a line of Operation, and the army will have as many Lines of Operation as there are sets of strategical lines.*

Ex. Taking the four strategical lines (already given) by which in the Austerlitz campaign Marmont, Ney, Soult, and Davoust marched from the base of operations to the primary objective which was the base of manœuvres along the line of the Danube from Dillingen to Ingoldstadt, we see that Marmont's line is entirely separated from the other three, which form together a set or cluster. There are then two lines of operation, the one being the area of ground included between Carlsruhe, Manheim, Heilbron, Stuttgard, Donauvert, and Ingoldstadt, the other coincident with Marmont's strategical line.

Ex.—The line of operation by which, in the same campaign, the army marched from Ulm to the second objective, which was Vienna, is the area of ground nearly in the form of a parallelogram, 60 miles wide and 280 long, which lies adjacent to the Danube from Ulm to Vienna, and has those places on its boundary as well as Landsberg, Munich, Salzbourg, Manarell, Bruck, Ratisbonne, Krems. This line of operation contains the strategical lines by which the army went from Ulm to Vienna.

DEF. 12.—*Every theatre of war is supposed to be divided into three Zones, by lines drawn from the side towards the base of operation of one party, to that towards the base of the other. These are called Zones of Operation, and are distinguished as the Right, Left, and Central.*

The object of this imaginary division of the theatre of war into three zones is, to facilitate the operations of the mind in deducing the best combination by means of the application of the principles of strategy to the physical configuration of the theatre of war.

To prevent any misapprehension of the meaning of the last paragraph, the principal data to be taken into consideration when forming the combination for a campaign, are:—

1. The physical configuration of the theatre of war, and the number, position, and strength of the artificial strategical points.

2. The relative positions of the armies.

3. The relative values of the armies as to numbers (taking into consideration the number of each arm), moral instruction, discipline, and experience.

4. The principles of strategy and tactics, including those

principal maxims of great commanders which are of recognized utility.

5. The Commander-in-Chief of the enemy.

Ex.—The theatre of war in the Austerlitz campaign was bounded on the north by the Mayn, the Eger, and high Elbe; south, by the Gulf of Gênes, Romagne, Illyria, and Croatia; east, by the eastern boundary of the Austrian Empire; west, by France. Then the right zone to a person looking at the map from the side of France will be the country south of the southern boundary of Switzlerland, the upper Inn, and the upper Salra. The central zone will be between the boundary of the right zone and a line drawn along the Danube from Vienna to Ratisbonne and continued to Carlsruhe. The left zone is the remainder of the theatre of war.

Def. 13.—*Strategical Reserves are detachments from the main body left to guard the communications.*

Ex.—In the Jena campaign the Prussians left a detachment at Halle for the purpose of securing their communications.

In the Rivoli campaign, when Napoleon marched to the Noric Alps, on the road from Italy to Vienna, the corps of Joubert left on the high Adige, and that of Victor at Verona, were strategical reserves.

Def. 14.—*Lines of Retreat are those strategical lines by which an army in the case of a disaster would retreat on a base of operations.*

Ex.—The Austrian lines of retreat from Ulm, in the Austerlitz campaign, were:—

1. The high road to Meiningen, by which they might retreat on the Tyrol (an Austrian province.)

2. The high road through Eglingen and Nordlingen into Bohemia (also Austrian.)

3. The high road through Augsbourg and Munich to Vienna. This latter was the most natural line of retreat,

since it led to the centre of the Austrian dominions—its desertion left the road to Vienna open—and a Russian army was marching by it to the assistance of the army at Ulm.

Def. 15.—*An artificial strategical point which is the immediate fulcrum or support of manœuvres in its vicinity is called, for the time being, a Pivot of manœuvres. (It is a magazine of food and ammunition.)*

Obs.—When the line of defence of a base of manœuvres is broken or turned, the fortresses on it become pivots of manœuvres.

Ex.—Brun and Vienna were pivots of operations before Austerlitz. Had these places been joined by anything like a line of natural obstacles, such a line, with these fortresses at its extremities, would have been a base of manœuvres.

Def. 16.—*A Pivot of Operations is a detachment of an army left stationary for the purpose of protecting, facilitating, or co-operating with the operations of the main army.*

Ex.—Marmont's corps-d'armée was stationed at Bruck and Leoben, during the same campaign, to induce the Archduke Charles, instead of returning with his army of 90,000 men direct from Italy to Vienna, to take the longer route through Hungary, thus giving time to Napoleon to defeat the united Russian and Austrian armies at Austerlitz. This pivot of operations was made for the purpose of impeding a junction. Pivots of operation have many uses.

Def. 17.—*The narrow strip of ground along which the portions of an army forming the front are dotted at intervals, is called the Strategical Front.*

Obs.—There is nothing in the definition of a strategical front which requires that the divisions of an army should be at rest, in order that the army shall have a strategical front. An army on march has a strategical front equally with an army at rest.

Ex.—On October 6th, before the battle of Jena, the Prussian strategical front was 75 miles in length, extending from Eisenach to Schleitz. Ruchel, with 20,000 men, was at Eisenach.

The King and Duke of Brunswick commanded 50,000 at Erfurt.

The Prince of Hohenlohe commanded 50,000 at Blankenheim.

Tauernzein commanded 10,000 at Schleitz.

The distance from Eisenach to Erfurt is 34 miles; from Erfurt to Blankenheim, 10 miles; from Blankenheim to Schleitz, 30 miles.

DEF. 18.—*Let a point at which a shock takes place between hostile masses be called a Decisive Tactical Point, or point of Collision.*

DEF. 19.—*Interior Strategical lines are such that the several fractions of the army moving on them are more easily uniteable in a mass or masses, so as either to lend one another a mutual support, or act unitedly and simultaneously at any point which may become a point of collision, and be always in superior numbers on any such point, than the fractions of the enemy are on the lines on which he is moving.*

Interior strategical lines are defined relatively to the strategical lines of the enemy. That which is required of strategical lines, in order to be interior, is, to use somewhat different words to those employed in the definition, that they should allow the army moving on them to have a tolerably decisive numerical superiority on any point which may become a point of collision.

Since interior strategical lines are defined relatively to the strategical lines of the enemy, the lines of either army are interior or exterior, according to the relation they bear to those of the other, and the same actual lines may be exterior or interior, according as the enemy chooses his own. The problem, then, of interior lines is simply an arithmetic one: Given, the rates at which the columns and those of the enemy can move, and the measurement of the roads, ascertainable from charts; are the forces more quickly unitable so as to lend one another a mutual support, or act unitedly and simultaneously in superior numbers on any point which may become a point of collision, than those of the enemy?

Ex. 1.—On October 6th, preceding the battle of Jena, Napoleon occupied the place of assemblement given as an example to the corresponding Definition 9. The strategical point of the Prussians at the same time has also been given as an example to Definition 17. Napoleon then was on interior strategical lines, and it was tolerably clear that the corps of Tauernzein, on the extreme left of the Prussian line, would be brought into collision with superior numbers of the enemy.

Ex. 2.—At the commencement of the Friedland campaign, the French army, 160,000 in number, occupied Guttstadt, Holland, Leibstadt, Mohrungen, Allenstein, while the Russo-Prussian army was posted as follows:—A Russian army of from 80,000 to 90,000 men was at Heilsberg, under Benningsen, occupying an entrenched camp; a Russian army of 30,000 was on the Niémen, about Tilsit; a Russo-Prussian army of 40,000 was near Konisberg.

The distance from Guttstadt is 12 miles; Leibstadt to Mohrungen, 8; Guttstadt to Allenstein, 16; Leibstadt to Holland, 17.

The distance from Heilsberg to Tilsit is 90 miles; Tilsit to Konisberg, 60; Konisberg to Heilsberg, 45.

The few remaining definitions are not strategical, but tactical; it is, however, necessary to introduce them.

DEF. 20.—*The lines on which the divisions of an army manœuvre after the armies come in sight of one another, are called Tactical Lines.*

Ex.—The portion of the high road from Brun to New Raisnitz, between Bellonitz and Posoritz, was a French tactical line, and the portion of the same road from Austerlitz to a mile and a quarter past Auberge, was an Austrian tactical line. (See a plan of battle of Austerlitz.) The by-roads from Pontowitz to Sbedschow, Ghirzekowitz to Krzenowitz, Telnitz to Augesd, were also French tactical lines.

Def. 21.—*The Tactical Front of an army is defined to be the strip of ground along which an army is arranged either continuously or at intervals, after the two armies come in sight of one another. The length of the tactical front is coincident with that of the line of Battle. The length is different for different battles, and may vary considerably during the same battle. The depth is also different: one mile may be given as a rough approximation.*

Ex.—The tactical front of the French at one time during the battle of Austerlitz, was the strip of ground about one mile in depth, and seven in length, containing Santon, Ghirzekowitz, Pontowitz, Kotelnitz, Sokolnitz, and Telnitz.

Def. 22.—*That portion of the enemy's line which it is most expedient to overwhelm is the Decisive Point of the field of battle.*

Def. 23.—*A Tactical Pivot is a point of the field of battle, as a wood, a fortified farm house, &c., of which it is necessary to obtain possession before proceeding to the grand attack of the decisive point.*

Def. 24.—*Interior Tactical Lines are such tactical lines that the several portions of the army moving on them are more easily unitable, so as to lend one another a mutual support, or act unitedly and simultaneously, and be in superior numbers on any point which may be made a decisive point of the field of battle, than the portions of the enemy are on the lines on which he is moving.*

Obs.—It will be seen that the definition of interior tactical lines is precisely analagous to that of interior strategical, and that the same observations apply for both.

ON STRATEGY.

The principles of Strategy are immutable under all circumstances; they never have admitted, and never can admit, the smallest change. The four principles of strategy are four clear, concise, definite, intelligible guides in the construction of all strategical combinations.

Principle 1.

To have as the object of all operations and manœuvres the bringing the mass of the forces successively into collision with fractions of the enemy.

Principle 2.

To operate as much as possible on the communications of the enemy without exposing one's own.

Principle 3.

To operate always on interior strategical lines.

Explanatory Principle.

Any strategical combination is more or less good, according as it is more or less in accordance with the three preceding principles simultaneously, and a combination which is as much as possible, under the circumstances in which it is constructed, in accordance at the same time with each of these three principles, is a perfect combination.

Obs.—The Generals who commanded the Austrian army in the Rivoli campaign, the Austro-Russian armies in the Austerlitz campaign, and the Prussian army in the Jena campaign, might find it a problem of considerable difficulty to base their combinations less on these four principles, without doing something positively outrageous, than they actually did. They not only themselves acted in direct opposition to these principles, but appeared to recognize no knowledge of them in their opponent. They were continually bringing fractions of their forces into collision with the mass of the enemy, uniformly on exterior lines, and constantly exposing their own communications without operating on the enemy's in the smallest degree.

One of the most remarkable and successful of the combinations of the wars of the French revolution, executed in 1793, and due to Carnot, may be taken as the first example of the manner of applying the principles of strategy to the construction of a combination. It would be desirable that the student, as soon as he shall have recognized clearly on a map of France the relative positions of the contending parties, should, before proceeding to the perusal of the combination actually made, consider for himself what combination the principles indicate.

DATA FOR THE COMBINATION.

The Austrian, Prussian, and English forces, divided into seven fractions, were thus disposed:—

1. The Duke of York was besieging Dunkirk, and Marshal Freytag was covering the siege.
2. The Prince of Orange was at Menin.
3. The Prince of Cobourg, with the principal army of the seven, was besieging Menin.
4. Benjouski was at Thuin and Charleroi.
5. An army was about Luxembourg.
6. The Prussians were besieging Landau, and the Duke of Brunswick was in the Vosges covering the siege.
7. General Wurmser was observing Strasbourg and the army of the Rhine.

The French had also seven inferior armies in face of the seven abovementioned, each of each.

Besides these, they had an army equal, suppose, in number to the difference between the seven French and seven allied armies.

The data to which the student may apply the principles of strategy, in order to form a combination, are complete.

. . . .

Carnot involved the Principle 1 alone in his combination, and sent the entire unoccupied army to Dunkirk, with orders that as soon as the marked numerical superiority thus given on that point should have decided the victory, to proceed to the next of the seven points, and when the mass of the French, again brought into collision with a fraction of the enemy, should have again given victory; to proceed to the next, and so on.

By this means the mass of the French was brought into collision with fractions of the enemy in the following manner:—

1. The Duke of York and Freytag were beaten—the former embarked, the latter retired.
2. The army passed to Menin, and the Prince of Orange was beaten.
3. The army arrived at Mauberge, and Clarfayt experienced a defeat in turn.
4. The army proceeded to the Vosges, and the Duke of Brunswick being in a minority, was likewise defeated.
5. The army having joined that of the Rhine, chased Wurmser from the neighbourhood of Strasbourg.

Hence one of the most remarkable and best manœuvres in the wars of the French revolution is nothing more than a simple deduction from Principle 1. The object Carnot had, when forming the combination, appears to have been nothing else than to bring the mass of the French into collision with successive fractions of the coalitionists. This combination was good, because it was in accordance with one of the principles of strategy; had it been in accordance with two, it would have been much better; if with the three first principles, as far as possible under the circumstances, perfect.

The five victories produced an imperfect, though a great result, because the enemy being attacked in front, he was driven back on his natural and prepared lines of retreat.

It appears that the Principle 1 might have been involved to the same extent, and the Principle 2 involved with it in addition, in the formation of a combination upon the same data in the following manner. After the victory of Dunkirk, the French army, instead of attacking all the while in front, and thus losing the best part of the fruits of victory, should take the Meuse, with its five fortified towns, as the base of manœuvres, and thus intercepting Benjouski, Clarfayt, and the Prince of Orange from their communications, attack them in reverse, or even in rear, defeat them (which would be an easier task than to defeat them in front), and drive them as vigorously as possible away from their lines of retreat.

Carnot has received generally great honor for his combination, and merits it, for, from the ordinary proceedings of the great majority of Generals of his day, it is greatly to be feared that, in almost any other hands than his, the additional army might have been divided into seven parts and sent to reinforce the seven armies.

Before giving a perfect combination actually made and executed, in order to show the way in which the principles of strategy are applied to the data in constructing a combination; and the influence of these principles, when applied, on the success of a war; the influence of principles on the choice and use of bases of operation must be discussed.

The principles of Strategy indicate that the most favorable form of a base of operations is that of the two sides of a right angled triangle, which contain the right angle so situated in the theatre of war that one of them is parallel, the other perpendicular, to the enemy's base. This arises from the power of operating on the enemy's communications without exposing one's own, which is obtained by entering the theatre of war at that extremity of the perpendicular portion of the base which is nearest to the enemy.

Ex. 1.—Take the theatre of war given as the second example to Def. 5, in the chapter on Definitions.

If, then, the country north of the Mayn were in the possession of the French, the base of the Mayn at right angles to that of the Rhine, thus forming a base like the two sides of a right angled triangle, is a base of the required kind. The portion of the base formed by the Rhine is parallel, and that by the Mayn perpendicular, to the Austrian base. The advantage which this base gives the French is, that it permits them, by acting from that extremity of it nearest the enemy, *i. e.*, by Bamberg and Bareith, to operate without exposing their own on the communications of any Austrian army that should venture west of a line drawn north and south through Bamberg. In this way the Austrian army would be driven into the angle of the Rhine and Mayn, cut off from their communications and lines of retreat (*i. e.*, from food, ammunition, and reinforcements), and, in case of defeat, destroyed by a pursuit which would drive them from their base, and should be carried on with the utmost possible vigour. In this case, if the French army were beaten, an event beforehand improbable, since it would be fighting from its communications, while the enemy would not, it would retreat on the natural prepared lines of retreat, and escape without, relatively speaking, serious injury.

Ex. 2.—The line of the high Rhine and the lake of Constance forms, in the same theatre of war, with the lower Rhine, a similar base for the French, supposing them to possess Switzerland. In A. D. 1800, the French having possession of Switzerland, Moreau employed this base. He caused Lecourbe to pass at Schaffhausen, while he himself, with the half of the army, crossed at Bale, and operating a junction at Engen, occupied Stockach, a decisive point on the Austrian line of retreat. In this way Kray, with 60,000 men, was shut in the angle of the high and low Rhine. Kray, seeing himself intercepted from his communications, returned by the way he went; Moreau met and defeated him at Engen.

Ex. 3.—Take the theatre of Italy, bounded on the north by the southern boundary of Switzerland, Tyrol, and the Noric Alps; south, by the Gulf of Genoa (Gênes), Romagne, and the Adriatic; east, by Illyria; west, by the Maritime Alps. This theatre, Switzerland being in the possession of the French, offers two rectangular bases. Lake Leman, the high Rhone, and southern mountains of Switzerland, form, with the line of the Alps, which run north and south on the west of Piedmont, a rectangular base. This latter chain forms, with the line of the Apennines, which run east and west, a second base.

Both these bases were employed by Napoleon in the manner indicated by the principles of strategy. The latter was employed at his début in Italy, at the commencement of the Rivoli campaign. The former was employed in the Marengo campaign, when he himself crossed the Great St. Bernard, and his Lieutenants, the Little St. Bernard, the Mount St. Gothard, and Mount Simplon.

In general, a base of any other shape which gives the power of operating from an advanced position in the theatre of war is indicated by Principle 2 to be very advantageous: for example, a base analagous in form and position to an angle which projects into the theatre of war so that the line bisecting it is perpendicular to the adversary's base.

Ex.—Bohemia, Switzerland, and the land inclosed between the Elbe and Spree.

It is now proposed, by means of an argumentative sketch of the Jena campaign, to illustrate the never failing influence of an observance and a non-observance of the principles of strategy on the success of military operations, and show how a combination is made by applying the principles of strategy and general maxims of war to the the data.

The data have been stated in the chapter on Definitions, and should be referred to.

Let us see what combinations the Principle 2 applied to the configuration of the theatre indicates to both parties, this being in general the first thing to be done in the construction of a combination.

The theatre of war is that given as Example 1 to the Definition 5.

Austria and Denmark are neutral.

The countries south of the Mayn, extending as far as the eastern boundary of Bavaria, are allied to or in possession of the French.

Russia and Hesse are allied to Prussia.

For the sake of conciseness, to save the unnecessary repetition of words which would too frequently occur, let F represent a French General, and P a Prussian.

The choice of a base of operations is the first thing to be determined by the application of Principle 2 to the theatre.

In selecting a base, the first question to be asked is, does the theatre offer a base of any of those kinds which have been determined to be the most advantageous?

Let F first construct his combination.

A glance at the theatre shows F that he has a base of the best kind, viz., that formed by the line of the Rhine from Mayence to the North Sea, and the line of the Mayn, the latter being approximately perpendicular to P's base.

F having ascertained that there is no other such base, it becomes very probable that it will be best to operate from that extremity of it towards P's base, i. e., by Bamberg and Cobourg; because it is very unlikely that Principle 2, of acting as much as possible on the enemy's communications without exposing one's own, can be better satisfied.

Let F, to facilitate the operations of his mind in applying the Principle 2 to the configuration of the theatre, and in order that no part may escape notice, suppose that it is divided into three zones, and consider in which it is best to operate.

For F to operate in the left zone is to risk being driven into the tongue of land between the North Sea and the rivers Weser and Elbe, and might lead to the destruction of his army. Suppose F got safely to the Elbe, he would be in danger from the right angled base formed by the Elbe above and below Landau; and he would run to almost certain ruin if he passed the Elbe above Sandaw, which would give P for base the projecting angular base formed by the Elbe and Spree, and allow him, by basing himself on Magdebourg and Dessau, to have the French communications completely at his mercy.

It is clear that there is no comparison between the right and left zones in point of the advantages they offer to F.

To operate in the central zone from Wesel and Mayence, by Cassel, Erfurt, and Leipsig, presents neither danger nor advantage; in other words, offers no facilities for acting much in accordance with or deviating much from, the principles of strategy.

Since by acting in the right zone F acts as much as possible on the communications of the enemy without exposing his own, and has also in this zone greater facility for the application of Principle 3, since his army advances in all probability much farther *en masse* and without collisions into the theatre, the principles of strategy applied only to a portion of the data, viz. the configuration of the theatre (which may be spoken of as Article 1 of the data for a campaign, 1 being the number which accompanies this article in the enumeration of data in the preceding chapter), declare that F is to operate by Bamberg and Culmbach.

Obs.—It must be remembered that it is asserted, that the principles of the science of war are only deducible from experiments. They are the result of generalization from experiments, not of reasoning on advantages and disadvantages. It is maintained that it is impossible to weigh advantages and disadvantages of the kinds involved, except by experiments. It is clear, however, that the principles of war ought to give to those who employ them, the preponderance of advantages in every individual case. The reader may be profitted, and perhaps amused, by contrasting the advantages and disadvantages (such as the possession of a portion of the theatre acquired by a march without collision) of the commencement of F's combination, determined on with those of any other commencement, taking, of course, only the same portion of the data.

Next, let P consider, from the same article of data, his best combination.

P, considering the theatre, sees, for the reasons already given, that if he be beaten in front, and retires beyond the Elbe, F must pass the Elbe below Sandaw. Hence the Elbe and Spree are equivalent to two bases of operation; as also, for similar reasons, the Oder and Warthe. The theatre offers to P no marked strategical advantage for the offensive, but, to compensate, is more than ordinarily good for the defensive.

P ought at once to see, by Principle 2, that any position west of a line drawn north and south through Culmbach is more or less dangerous, according as it is more or less towards the south-west corner of the theatre of war.

Since P finds no marked strategical advantages for the offensive, the next thing for him to do is, obviously, to consider the defensive powers which the theatre offers to him in relation to the principal offensive strategical combinations which it offers to F.

P now determines that it is most probable that F will commence in the way in which F has decided from the principles he ought; for P has, in his own mind, put himself in

F's place. It remains then for P to consider the necessary steps to defeat the combination to which such a commencement leads, neglecting no opportunity of assuring himself whether it is F's intention to act according to the most probable hypothesis.

P sees that two courses lie open.

1 To remain well massed together on the high Saale or high Elster, with his left wing supported on the confines of Bohemia and right in advance, taking the line of the Elbe from Wittenberg to Dresden as base.

2 To take up a defensive position before Leipsig, with excellent lines of retreat open on Dessau, Wittenberg, Turgau, and Magdebourg.

But the fact which P especially remarks and regards is—

That any position to the left of a line drawn north and south through Culmbach is more or less dangerous, according as it is more or less towards the south-west corner of the theatre of war.

It now remains for P and F to introduce the modifications required by Articles 3, 4, 5, of the data.

Data of Article 3.

The French can bring into the field more than 150,000 men, composed of the Veterans of Lodi, Marengo, Rivoli, Arcole, Ulm, Austerlitz.

The Prussians can bring about 120,000 new and inexperienced troops. Discipline, very good.

Data of Article 4. The principal parts of the data of this article which have not been considered, are furnished by maxims 1, 4, pages 9 and 10.

Data of Article 5.

For the Commander-in-Chief of the French, the data are the histories, or at least, the principal operations of the campaigns, of Rivoli, the Pyramids, Marengo, and Austerlitz.

In particular—On September 26th, Napoleon left the Rhine.

On October 19th, the destruction of an army of 85,000 men was completed by the surrender of Ulm, when 30,000 men and 16 generals laid down their arms, surrendering as trophies 40 standards, 60 pieces of Artillery, and 3000 cavalry horses. On November 15 Napoleon was at Vienna, having in this last interval of not quite a month marched 320 miles, crossed the Lech, the Iser, the Inn, the Salra, the Traun, and the Emes, and fought in five partial combats.

For the Prussian Generals.

"The Prussian Generals are brave. Brunswick and Mollendorf are very old. Age had congealed in them the qualities whose exertion many years before, in the war of seven years, had given them their reputation, and had not given them genius, which is never the fruit either of age or experience.

Hohenlohe and Massenboch had just sufficient mind and knowledge to have become penetrated with the most false of the pretended principles, or rather maxims, of war."*

With regard to the remaining Prussian General, the *celebrated Blucher,* Jomini and many other writers have asserted, that he was entirely ignorant of the principles of war. Candour must reluctantly admit that it is difficult to explain on any other hypothesis this Marshal's singular operations on the Marne, in 1814, when he divided an army of 60,000 into four divisions of 5000, 15,000, 19,000, and 21,000, and separated them by large intervals, in direct opposition to Principles 1, 3. The result was, that Napoleon overwhelmed each of these divisions successively in the combats of Champ-Aubert, Montmerail, Chateau Thierry, Vauchamps, and Eloges, which cost the Marshal 20,000 men, killed and prisoners.

F decides that it is to his interest that the first collisions shall be as serious as possible, that P's army may be overthrown before it has had the time to learn the difference between a battle and a review. F determines, then, that he is to apply the principles of strategy with the utmost vigour and boldness; for the bolder the operations, provided they be just consistent with the principles, and the more serious the first collisions, the greater the sphere and opportunity for the experience of his army and the superiority of its commander to make themselves felt.

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* *This paragraph is a literal translation from the portraits of the Prussian Generals, given by the Baron de Jomini, General-in-Chief, Aide-de-camp of S. M. the Emperor of Russia, some time Chief d' etat major of Ney's corps-d' armee, author of a treatise on the "Science of war," for the use of Russian Officers, &c, &c.*

P deduces the following conclusions:—

1. That any position to the left of a line drawn north and south, through Culmbach, is absurd and dangerous in the extreme.

2. That it is to his advantage that the first collisions should be as little decisive as possible.

3. That he ought not to incur the smallest risk he is able to avoid, of being obliged to fight otherwise than with his back well turned to excellent lines of retreat, all of which should be in the highest possible state of preparation, every bridge mined, &c.

4. That every fortified place should be put into the best possible state of defence, to give shelter to the army in case of disaster, and allow time for its reorganization.

5. That Plauen and Schleitz are two of the most decisive points in the theatre of war, and that the army should be concentrated on as small a strategical front as possible, on a line behind or before Plauen and Schleitz, according to the configuration of the ground.

Obs.—A month before the commencement of the Jena campaign, General Jomini, certain that the commander-in-chief under whom he had served in the Austerlitz campaign, and to whom at Ulm he had rendered important services, was the man of all others the most capable of applying vigorously the principles of strategy, predicted publicly at Paris, as the result of his investigations, that if the Prussians passed the Saale, it would be in the neighbourhood of Gera, or Jena, that the decisive battle would be fought.

The position of the two armies on October 6th was as follows:—

The French and Prussians occupied respectively the place of assemblement and strategical front given as examples in the preceding chapter to Defs. 9, 17.

Before proceeding to the history of the rest of the campaign, let F and P represent, as before, a French and Prussian General; suppose them appointed to command the armies already in the positions of Oct 6th. Then F and P have, besides all the data they had before, the additional data furnished by the knowledge of each other's positions. F and P have now to determine what is to be done by means of the principles of strategy and general maxims of war.

F concludes:—

1. That the relative positions are such, that, in order to make a simple but splendid application of Principles 1, 2, he has only to move northward with all possible boldness and vigour.

2. That the configuration of the roads is very favourable to this proceeding, and offers as lines of manœuvres, the lines which the reader will find as an example.

3. That the lines of manœuvres offered are very favourable to the application of Principle 3, since all three lie within a strip of ground 28 miles across at the widest part.

4. That if he operate with the utmost activity, and so prevent P from having time to see and rectify his very bad position, he may operate with all the four principles in his favour; that time is invaluable in war as in most other things—a lost opportunity never returns.

5. That he has two things which he must do simultaneously with the utmost possible quickness. To place himself between P's army and its communications—to defeat P.'s fractions separately, before they can concentrate.

P. concludes:—

1. That principles 1, 2, 3, are on the side of the enemy, as well as the general maxims of war.

2. That concentration and great activity can alone save him (P). Concentration may turn principles 1, 3, in his favour, activity may render Principle 2 neutral.

3. That he has two things which he must do simultaneously with the utmost possible quickness. To concentrate—to regain his communications.

4. That Leipsig must be named as the place of assemblement, and that each of the four divisions of the army must march to it by the shortest road as quickly as possible.

5. That he must himself go as fast as possible to Leipsig, to choose his field of battle and make the necessary tactical dispositions.

6. That the divisions at Erfurt, Blankenheim, and Schleitz, can with safety take the shortest roads (Map 2) to Leipsig, where they ought to arrive from one to two days before the enemy. That the division at Eisenach must not take the shortest road, by Erfurt and Naumberg, for fear of being intercepted at the latter place, but must go by Weissensee, Sangershausen, and Halle.

To continue the history of the campaign:—

Napoleon simultaneously with occupying his place of assemblement, sent Augereau from Frankfort along the high road marked in Map 2, to Cassel. The object of this manœuvre was evidently to draw the enemy towards the south-west corner of the theatre, by giving him hopes of falling on an isolated corps. It is curious how completely the route of this column traverses the portion of the theatre most dangerous to the Prussians. On learning the disposition of the Prussians along their strategical front, Napoleon orders Ney to take the right hand line of manœuvres; Bernadotte, Davoust, and Murat, to take the centre line; Lannes and Augereau the left.

Oct. 8.—A detachment of the army of Tauenzein (who appeared incapable of keeping even 10,000 men together without making a detachment that he might act on exterior lines, and bring fractions of his army in collision with the mass of the enemy), was overthrown by Murat at Saalberg.

Oct. 9.—Tauenzein was himself attacked and easily overthrown by Bernadotte.

Oct. 10.—At Saalfield, Lannes defeated a portion of the army of the Prince of Hohenlohe (who in turn appears to have been incapable of resisting the mania for making detachments), took 1000 prisoners and 30 pieces of artillery. The Prince Louis of Prussia, who commanded this avant garde, which, being unsupported, was nothing less than an absurd detachment, blew out his own brains from a sense of honour.

Oct. 12.—Napoleon had passed beyond the left of the Prussians, by anticipating them at Gera, his own left then formed the pivot of a conversion of the front of the whole army, so as to cut the enemy entirely from his base.

Oct. 13.—Davoust, Bernadotte, and Murat arrived at Naumberg, where, being on the line of operations which legitimately belonged to the Prussians, they seized upon very considerable magazines of food and ammunition, not intended but destined for them.

Soult was between Jena and Gera.

Ney, at Roda.

Lannes, at Jena.

A Bavarian division, at Plauen.

On the same day the Prussians were concentrated about Weimar.

Obs.—The result of the campaign may from this moment be almost considered as decided. The Prussians were entirely cut from their base by a superior force. A series of extraordinary accidents could alone restore them their communications without a very decisive battle (in which they would have to fight in order to cut their way through the enemy), since it must be remembered that the framework of the army on their communications was composed of the men who had crossed the St. Bernard, passed the fort of Bard, and marched in less than a month 430 miles, from Ulm to Brunn; crossing five rivers and engaging in five combats.

The Prussian generals divide their army into two fractions, in opposition to principles 1, 3: 50,000 go to Jena, under the Prince of Hohenlohe; 40,000 under the King; Blucher and the Duke of Brunswick march towards Naumberg, to regain the Elbe as fast as possible. Davoust, Bernadotte, and Murat were already at Naumberg.

It is difficult to see what it was intended the Prince, thus abandoned in the midst of the whole French Army, should effect. If Ruchel had not proceeded with his 20,000 men to support the Prince, one might suppose that it was thought expedient to sacrifice 60,000 men to save the rest.

Oct. 14.—The Prince of Hohenlohe was overthrown at Jena. Ruchel came too late on to the field, when all was in fact most evidently lost, and was defeated in turn.

The army of the King met the Corps of Davoust near Auerstedt, and were beaten by about one half their number, owing, as might have been anticipated, to observing far too strictly the distances and regulations of parade.*

On this day the French took 60 standards, 200 pieces of Artillery, and 25,000 prisoners.

The capitulation of Stettin, a place 200 miles from Jena, measuring in a straight line, concluded on the 28th of October the absolute and entire surrender of Prussia, west of the Oder.

Thus in seven *weeks* was the monarchy of Frederick the Great overrun and subjected to the most complete humiliation. The sword and haussecol which he carried through the Seven *Year's* War, were among the spoils. So do nations rise and fall according to the men whom birth, accident, or intrigue appoint to preside over their destinies.

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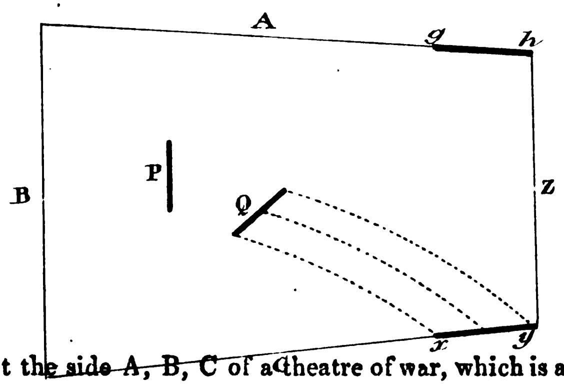
* Vie de Napoléon, by Jomini.

A very simple application of the principle 2, given in Jomini's and two or three other treatises on the science of war, may be inserted here, as it will, perhaps, serve to give familiarity with the application of the principles to the construction of combinations.



Let the side A, B, C of a theatre of war, which is approximately a parallelogram, be in the possession of one of the parties; and the remaining side, Z, in the possession of the other; so that A, B, and C form the one base of operations, Z the other.

Let the army belonging to the base Z have advanced into the theatre of war, and taken up the position P. Then, in order that the other army may apply as fully as possible the Principle 2, it must start from a portion, *x y* or *g h* of the extremity, towards the enemy of A or C. In other words, the army belonging to the base A, B, C has two rectangular bases, and must start towards the enemy from the extremity of the portion of one or other of these two bases, which is perpendicular to the enemy's base.

Let Q represent the army belonging to A, B, C. If, then, Q leaves *x y* and follows the dotted lines till it arrives at the position Q of the figure, it will have cut P from its communications.

Q might with equal propriety have left *g h*.

Suppose A to be neutral territory, or sea, of which the army belonging to B, C has the undisputed possession, owing to naval superiority, then Q would, in the first case, have only the *x y* from which to start, and in the latter would have both *g h* and *x y*; but *g h* would be a maritime base, and would be supplied with food and ammunition by means of ships. In both cases, in all other respects, the application of Principle 2 would be made in the same way.

Suppose A, B, C to be all seas, of which one side has undisputed possession.

Let the English have possession of these seas.

Let the parallelogram A, B, C, Z represent Spain south of the Tagus.

Let Z belong to the French.

Then the maritime base, *g h*, represents Torres Vedras.

THE MARENGO CAMPAIGN.

The Marengo campaign will now be employed for the same purposes for which the Jena has been employed viz., to show how strategical combinations are formed by the application of the principles of strategy and general maxims of war to the data; and, to show the influence of the principles on the success of a campaign, by remarking carefully when these principles change sides, and in favour of which side they are fighting.

The theatre of war (*i e*, the whole area of ground necessary to be taken into consideration in forming the combinations) comprises France east of the Rhone, Piedmont, Lombardy, the Venetian States, and Tyrol (Map 1).

Switzerland was in the possession of the French.

At the commencement of the campaign, an Austrian army, under Melas, having the Alps from Nice to Mount Blanc as a base of manoeuvres, were menacing with invasion the southern provinces of France.

The disposition and strength of the forces destined to take part in the campaign were as follows. On or about May 8 :—

Thirty thousand Austrians on the Var, under Elnitz, were endeavouring to carry the war into the southern provinces of France.

In Liguria, 35,000 men, under Ott, were besieging Massena in Genoa (Gênes).

The Austrian General Briey, with 3000, was about Asote guarding the Valley of the Dorea.

The Austrian General Landon was guarding the defile of Mount Simplon with 3000.

Wickassowich, with 7000, was on the high Tessin at the foot of Mount St. Gothard.

Haddick, with 5000, was at Ivrea.

The road and valley of Susa were occupied by 5000.

The road and valley of Pignerol were occupied by 5000.

The road and valley of Coni were occupied by 5000.

The whole Austrian army thus disposed amounted to about 92,000 men; there were in addition; garrisons in the towns and fortresses of Piedmont and Lombardy.

About the same time, 8th May.—

Massena was in Jenoa with 12,000.

Suchet was on the Var with 9000.

Thureau in Dauphiny with 4000.

Buonaparte near Geneva with 40,000.

Moncey was to bring 20,000 men from the army of the Rhine to take part in the campaign.

The whole French army thus disposed amounted to about 85,000.

The discipline, arms, and experience of the two armies was about the same.

The Commander-in-Chief of the French was superior.

The configuration of the theatre may be seen by reference to Map 1.

By referring to the articles chapter 1., pages 9, 10, which state the data requisite, it will be seen that the data is now perfect.

Switzerland was given as one of the examples of a projecting angular base. The north side of this salient, from the eastern boundary of France, is the French strategical key to Wurtemburg and Baden, and the south side of Piedmont and Lombardy.

On considering the data, two things become immediately apparent to a French general.

1. The necessity of relieving Massena in his perfectly isolated position.

2. The existence of two rectangular bases (given as examples in an earlier part of this chapter) of the most favorable kind, of which one is, by the disposition of the forces, rendered unavailable.

It was possible to relieve Massena in two ways:

To attack the enemy in front on the Var, and again on his base of manœuvres on the Maritime Alps—a base so strong that it differs little, if at all, from a second base of operations.

To employ the salient rectangular base formed by the Lake Leman and the Rhone, to approach Milan, Pavia, Tortona, and thence Genoa.

The second of these methods is, both for the purpose of relieving Massena, and for the general success of the campaign, the absence of principles.

Accordingly, General Buonaparte decided on the second method, because it allowed a splendid application of Principle 2, which the other excluded, and promised excellent opportunities of applying 1 and 3, very much greater, indeed, than could be expected from an attack in front; and, as well, was the application of all the most prominent general maxims of war, while the extraordinary character of the operation was calculated to lull suspicion, and gain all the advantages of a surprise.

It is perhaps necessary to anticipate an objection. It may be said, the passage of the St. Bernard was so extraordinary and gigantic an undertaking, that it must not be considered as an application of the principles of strategy.

The reply is, either the general who had conducted the Rivoli campaign—a campaign which certainly was one of the most wonderful, perhaps the most wonderful, as a series of applications of the principles of strategy which the military annals of the world can supply—and whose first step to eminence was a most brilliant application at Toulon of Principle 2, did or did not know and believe in the principles of strategy.

If he did know the principles of strategy, the passage of the St. Bernard was necessarily an application of them.

The principles of strategy are to be found in Napoleon's notes and memoirs in almost the same terms in which they have been stated; and these notes and memoirs abound with maxims for particular cases, all classifiable and reducible to these principles.

Again, Buonaparte knew nothing personally of the St. Bernard till the army arrived at it, and certainly had no knowledge of the strength and situation, if even of the existence, of the Fort of Bard. The only knowledge which Buonaparte appears to have had of the St. Bernard was the official information furnished by the celebrated general of engineers, Marescot, whose notion of localities, by which it is possible for persons to pass, is highly creditable to him. It is quite certain that Buonaparte had beforehand no adequate conceptions of the difficulties of the strategical line he was taking; of the Fort of Bard—after all the great difficulty—and of its strength and situation, he was confessedly ignorant. It is probable, from his character, that, had he known all the difficulties, he would have gone on just the same; if so, the argument is strengthened.

When Melas, the Austrian general-in-chief, heard that the

French army was assembled about Geneva, he looked upon it as a diversion in favour of Massena, but prudently detached 8000 men from Ventimille, a portion of the army of the Var, and 10,000 from the army of Liguria, and with these he marched to Turin.

The points on the perpendicular base at which the divisions of the French army enter the theatre of war are great St. Bernard, Little St. Bernard, Mount Simplon, and St. Gothard.

Buonaparte, with the main column of 35,000, enters by the Great St. Bernard; a column of 4000 enters by the Little St. Bernard, a column of 1500 enters by Mount Simplon, over which there appears to be a road passable for all arms. General Moncey, with 20,000 detached from the army of the Rhine, receives orders to enter by the St. Gothard, across which there was also a similar road.

Buonaparte, wishing to deceive Melas as to his combination, and retain him in the extreme west of the theatre of war, i. e., in the most dangerous part, orders Thureau to attack Susa. The analogy between this manœuvre and that executed by Augerau in the Jena campaign is obvious.

May 22.—Thureau attacks Susa and obtains a success.

Buonaparte is occupied in passing the Fort of Bard.

Melas, on his road to Turin, heard that troops had been seen on the top of the St. Bernard; but deceived by the immense difficulties of the route and Thureau's detachment, he not unnaturally concluded that no attack was to be expected from that quarter, and detached on Susa the main body of the forces he had brought with him from the Var and Genoa, while himself returned to Saviglione.

The map sufficiently indicates that the road by which the main French column descended from the St. Bernard on the Austrian communications; was that by Etroubles, Chatillon, Bard, and Ivrea.

May 24.—Buonaparte, with the principal column, was at Ivrea.

The remaining French columns were respectively at the point of passing the Little St. Bernard, the Simplon, and St. Gothard.

Melas was at Saviglione, still in ignorance of the great combination, which, having overcome its unexpected difficulties, was now majestically developing itself.

The disposition of the forces which has been given, shows that the force would resist the entrance of 60,000 French by their strategical lines consisted of 18,000. The Fractions of these 18,000, scattered at intervals along the lines of the advancing columns, were successively overthrown, and thus principles 1, 3, were introduced into the combination equally with 1.

To continue the strategical lines of the French columns.

The avant garde took the road from Ivrea to Folizzo, attacked a body of 10,000 under Haddick, and forced the Bridge of Chiusella, May 26.

May 27.—Lannes entered Chivasso.

The advance to Chivasso was only to deceive the enemy by a pretended approach to Milan,. since Principle 2 indicated an easterly movement towards Milan.

The French communications were open so long as the route of the St. Gothard was open, and every step towards Milan rendered the French lines more and more interior, since the main column approached more and more nearly to a junction with the remaining columns of the Simplon and St. Gothard.

The main column takes the road from Ivrea by Santhia, Verceil, and Novara, to the Tessin: the avant garde, under Lannes, becoming arriére-garde, and Murat commanding the new avant garde.

May 31.—Murat attacks Landon; and Wickassowich (who had come to the assistance of Landon, with the 8000 men who were on the high Tessin) forces the passage of the Tessin at Turbigo, pursues the enemy, who falls back behind the Mincio.

The columns of St. Gothard and Simplon were respectively at Bellinrona and Domo Dossola.

June 5.—Massena capitulated after a resistance which will confer eternal honour on his name. The terms of capitulation liberated the whole of the garrison to the number of 8000. Of these 6000 joined Suchet at Savonne, to which place he had advanced in consequence of some successes and the orders which Elnitz had received to join Melas at Alexandria. After this junction, which took place June 8, Massena and Suchet took the road to Aqui, at which place they were on the day of the battle of Marengo.

June 4.—Ott left Genoa as soon as the capitulation of the garrison rendered his forces disposable, and took the road by Gavi, Novi, and Tortona to Montebello, where he took up a position.

June 6.—The disposition of the French were as follows:—Lannes was passing the Po at St. Cypriano—Murat, at Nocetto, easily overthrowing the detachments which opposed them. General Buonaparte was preparing to follow on the next day. These forces under Buonaparte, Lannes, and Murat, amounted to 30,000.

The remainder of the army, in number 30,000 were disposed on the left bank of the Po and on the communications. Ivrea, Chivasso, Crescentioro, and Trino were occupied; Arona, Pizzighetone, and the citadel of Plaisance were blockaded.

The column of the St. Gothard was occupying Pavia, Crema, Breschia, and blockading the citadel of Milan.

The only forces which crossed the Po were those which crossed with Lannes at St. Cypriano, with Murat at Nocetto, and those which Buonaparte accompanied, June 7.

Jomini remarks, that Buonaparte would have acted more in accordance with the principles of Strategy if he had made 45,000, instead of 30,000, cross the Po; for it was exceedingly probable that the Austrian General, would determine on fighting a battle in the neighbourhood of Alexandria, where he was concentrating 50,000 men; and to have less than 30,000, out of 60,000, on the field of battle, was scarcely to comply with Principle 1, and bring the mass of his forces in contact with fractions of the enemy.

Melas, as soon as he heard the danger which threatened his communications, determined on a vigorous concentration, which turned Principles 1 and 3 in his favour, and ordered Elnitz and Ott to join him at Alexandria.

The following are the apparent reasons which determined Melas to take the offensive and fight a battle near Alexandria, and ought, according to Jomini, to have given Buonaparte a much stronger opinion than he in fact entertained that Melas would follow this course, and hence have induced him both to lead a greater number of men across the Po, and to remain after crossing much more concentrated than it will be seen he did.

1. To effect his escape by Valence and Milan to the Mincio and Mantua was to allow Italy to be conquered by marches.

2. That the probabilities were greatly in favour of his having a decided numerical superiority on the day of battle, so many of the French being left on the left bank of the Po.

3. That his orders, if executed without accident, would give him 50,000 on the day of battle with which to attack less than 30,000 with an inferior artillery.

4. That he had 10,000 cavalry, which gave a very decided superiority in that arm; the plain between Serivia and the Bormida was exceedingly favourable for cavalry, as also the country in general about Alexandria.

5. That he would have two of the three principles of strategy in his power, while the other had not operated sufficiently long against him, to produce nearly its full effect;

a decisive victory under the walls of Alexandria would destroy all that Buonaparte had effected by so great genius, labour, and intrepidity, and re-conquer Italy to the Austrians.

Ott gave battle at Montebello to the avant garde of the French under Lannes, and suffered a disastrous defeat. In doing this, Ott acted contrary to the orders of Melas; and, in thus engaging a force considerably superior to his own, violated as much as possible Principles 1 and 3, at a time when the success of the campaign and possession of Italy depended on a more or less vigorous application of them.

Suppose a person in Ott's position to be unacquainted with the principles of strategy and general maxims of war, though deprived of these honest, sure, and perfectly intelligible guides, and left to his own resources, he ought at least to have seen—

1. That Melas had better means and information from which to judge what was to be done than he had.

2. That to engage his men with even an equal number was to engage them less advantageously than they might be engaged a few days later, when they would form part of a superior force attacking an inferior.

The affair of Montebello was most unfortunate for the Austrians; engaged with a superior force, they lost 3000 killed and wounded, six cannons and 5000 prisoners. A numerical superiority generally affects to an enormous degree the number of prisoners. After the defeat Ott put 2000 men into the Citadel of Tortona; it is difficult to suppose these 2000 men very well employed.

Ott's manœuvres diminished in this way the numerical superiority of the Austrians on the decisive field of battle for which Melas was preparing by 7000 men; supposing the number of French put hors-de-combat to be 2000, the loss of the Austrians being 8000, and 1000 being considered sufficient to defend the citadel of Tortona for a week.

June 13.—Buonaparte crossed the Serivia at eight o'clock in the morning and the enemy, offering him little resistance, advanced on that day to Marengo. Buonaparte detached Dessaix, with 6000 men, to Rivalta, on the information of a double spy, who told him the enemy intended to escape by Novi, Geva, Parma, Modena, and Borgoforte, to Mantua. This detachment appears contrary to the Principles, and very hazardous: also contrary to Buonaparte's own maxim 2 (page 342), and, as well, what it was intended to gain by it in any case is not very apparent. The French General had ample leisure on the morrow to regret his detachment.

May 14.—At the break of day Melas passed the Bormida with 40,000 men, of which 10,000 were cavalry, and 45 pieces of Artillery. The French were vigorously attacked and defeated; they retreated backwards for three miles along their whole tactical front. All the French generals, Berthier in particular, considered the battle decidedly lost. The Austrians on their side, were equally certain the battle was won. Melas left the field to hasten the arrival of the news at Genoa and Vienna, leaving Zach to gather the fruits of the victory. Zach, anticipating no further resistance, advanced in a column along the high road from Alexandria to Tortona, doubting so little of the completeness of the victory that he allowed an interval of three quarters of a mile between the first division of 5000 select troops which he led in person, and the next corps, composed of the divisions of Kaim, Bellegarde, and Elnitz.

About five o'clock in the evening Dessaix's division arrived at St. Guiliano—rather late, since the battle began at day break. Fifteen pieces of artillery being unmasked opened on the first division of the processional column of the Austrians, when the mouths of the pieces almost touched the front ranks. The ravages thus made are described as tremendous; the Austrians, astonished and little expecting any thing of the kind, were attacked at the same time by Dessaix's infantry in front and Kellerman's cavalry in flank.

The account of the battle has only been carried on in this imperfect manner thus far, because the strategical combinations of the campaign and their effects would be incompletely given if it stopped before Dessaix's arrival. One other fact remains. Melas at a very early period of the battle detached the half of his cavalry to Aqui, to observe Massena and Suchet.

To consider this campaign with a view to observe the influence of the principles of strategy on its success.

Up to the time of the victory of Montebello, Buonaparte had all the principles with him, and up to that time had the most complete success. By allowing too great a portion of his army to remain on the left bank of the Po, he then allowed Principles 1 and 3 to pass to the side of the enemy and increased his violation of them by Dessaix's detachment. Melas, with 1 and 3 in his favour against 2, attacked the French, May, 14, and was, at four o'clock in the afternoon, decidedly victorious and in complete possession of the field. Melas, by a detachment of one half of his cavalry, in opposition to 1 and 3, rendered his victory much less decisive than it would otherwise have been, and prevented himself, by the absence of the most important arm in the circumstances in which he found himself, from pursuing with the requisite vigour, and destroying the French army before the arrival of Dessaix. On Dessaix's arrival, in consequence of the construction of the professional column on the road to Tortona with three-quarters of a mile between the first division and the main body, the principle of interior tactical lines passed to the French, and produced its effect, among other causes, in deciding that the victory should remain with the French.

It will probably be admitted that the conduct of the campaign confers honour on Melas. Since it can hardly be expected that he should bave anticipated the passage of the St. Bernard and Fort of Bard, two faults alone appear to remain—the detachment of cavalry on the morning of the battle and he himself leaving the field.

GENERAL MAXIMS OF WAR.

1. When an army is experienced and warlike, that of the enemy newly levied, or from long peace inexperienced in war, it is a maxim to endeavour by all possible means to force the enemy as soon as possible to a decisive general engagement. If, on the other hand, the case be reversed, one must fortify defiles, endeavour to bring about partial engagements on very favourable and, if possible, entrenched ground; make a liberal use of field works; and, when a general engagement is determined on, take up a strong position, fortified as much as possible, and with the back well turned to good prepared lines of retreat.

2. Before a battle, every battalion and squadron which it is possible to bring on to the ground must be brought; one battalion and one squadron may decide the fate of the day.

3. In carrying on war in the mountains one must always act tactically on the defensive. The object of all combinations is to oblige the enemy to attack and engage in none but defensive battles.

4. Nothing is more important in war than unity of command. Hence an army ought always to be under the control of a single will.

5. The Officer in command of a detachment receives instructions before being detached. Having received instructions he must be free to act as he chooses, and quite independently, in the accomplishment of his object. If new instructions arrive he must of course attend to them, but must never be allowed to waste his time waiting for orders.

6. Never do what the enemy wishes for the simple reason that he does wish it. Hence, for example, a field of battle which the enemy has studied and reconnoitred is to be avoided, still more so one which he has entrenched and fortified. A consequence of this maxim is, never to attack a position in front when it can be turned.

7. The Officer in command of an army or of any portion of

an army, when in the neighbourhood of the enemy, ought frequently to say to himself, " What should I do if the enemy appears in front? what, if on the right? what, on the left?"

8. An army or portion of an army ought to be ready at all hours, both by night and day, to oppose all the resistance of which it is capable. Hence the soldiers should always have their arms and ammunition; the infantry should always have with it its artillery and cavalry; the different divisions should always be ready to support and protect one another.

9. When a general is evidently winning he ought on no pretence to keep any fresh troops for the next day, but engage every man he has. A complete success places the moral of the two armies in such a relative state, that the triumphs of the morrow are certain. (This maxim is, in fact, a principle of tactics.)

10. Heavy artillery and baggage-waggons must not enter a defile, the opposite entrance of which has not been secured, they must be left in position, under a suitable escort, till the entrance is secured.

NAPOLEON'S MAXIMS.

1. Tactics must be changed every ten years if one wishes to preserve a superiority.

2. No detachment must be made, under any circumstances, on the evening before a battle.

3. There is a moment in battles when the smallest manœuvre or the smallest number of troops decides and gives the superiority.

4. In war as in politics the lost moment never returns; Fortune is a woman, and it is necessary to profit boldly by every opportunity.

5. Every general ought to know how to excite and utilize enthusiasm; a man, who is in all other respects a great general, if he cannot do this is only an ignorant officer.

6. A state can only acquire efficient officers by taking care of their education and protecting the sciences.

7. A battle ought never to be fought except with seven chances to three in favour; even then it should not be begun until there are no more chances to expect from delay.

8. An army passes every where, and at all seasons, when two men can stand abreast.

Obs.—Some doubt may, perhaps, be entertained of the practical character, as well as the possibility, of always regarding the maxim 7.

It is manifest, from the consideration of the principles of strategy, how great an influence the rate at which an army marches has on its strategical operations. Lines which on the map, when considered with regard to distances and position alone, are exterior lines, may be interior to the army moving on them, in consequence of the difference of the rates at which the two armies march. To take a simple instance: suppose two adverse armies are on the same high road, each army being in two divisions separated by an interval. Let the one move at the rate of 25 miles a day, the other at that of ten miles. Let the interval between the divisions of the former be 100 miles, that between those of the latter 50 miles.

Let the armies march, preserving these respective intervals between their divisions till the advanced divisions meet and engage; that which marches at the rate of 25 miles a day is, if its position on the map be considered with regard to distance only, on exterior lines; but its superiority in marching renders it in reality on interior lines, for its second division will join the first in four days, while it will require five days for the junction of the divisions of the other.

Hence, that of two armies which marches the faster will, if the difference be at all considerable, possess great strategical advantages over the other.

The advantage of maintaining as large a strategical front as possible, in order to keep the enemy as long as possible in ignorance of the point on which it is intended to strike a decisive blow, is sufficiently obvious. Hence that which is required in order to the perfect application of the principle of interior lines before that period of an operation, when it is clear the object of the combination is apparent, is, to have as large a strategical front as possible, consistently with the maintenance of interior lines.

Since the greater the rate of marching, the greater the power of interior lines, the greater therefore is the strategical front which can be maintained.

The ordinary manœuvres to which the desire of maintaining as large a strategical front as possible leads, are—

1. To make the divisions of an army start from several points at a distance from one another, to meet at a common place of assemblement.

2. To cause the divisions to start from the same point by different roads leading in all directions from that point.

In both these cases the marches will have to be calculated and ordered so that interior strategical lines may be observed. In the first manœuvre the strategical lines and marches must be so ordered that the army may be certain of uniting at its place of assemblement before the enemy can arrive, intercept, and defeat its divisions separately. In the second, so that the divisions, by falling back upon or repassing the central point, may be capable of being in superior numbers on any point which may become a point of collision.

Buonaparte stated that the rate at which a French army marched was 25 English miles a day. He also said that, if two armies are equal in all things except numbers and rate of marching, the relative values of the two armies will not be found by comparing their numbers, but by comparing the products of their numbers and rates.

Ex. 1.—Compare, by Buonaparte's rule, the values of an army A, of 20,000, which marches at the rate of 18 miles a day, and an army B, of 30,000, whose rate is eight miles a day.

$$A : B = 20{,}000 \times 18 : 30{,}000 \times 8.$$
$$= 2 \times 9 : 3 \times 4.$$
$$= 3 : 2.$$

Ex. 2.—Compare the values of an army A, of 60,000, whose rate is 24 miles, and an army B, of 80,000, whose rate is 18 miles.

The Austerlitz campaign will now be given for the same purposes for which those of Jena and Marengo have been employed, with the additional one of remarking the rate of marching and obtaining approximate notions of the rates at which armies do and can march.

The campaign of Austerlitz was the result of a coalition between Austria, Russia, England, and Sweden.

FORCES OF FRANCE AND THE COALITION.

The emperor of Russia was to furnish 100,000 men at least.

The army of Austria amounted to 270,000.

An Anglo Russian army of from 20,000 to 30,000 was to enter Hanover and Pomerania to join Gustavus IV., who had certainly more than 25,000.

Taking the sum of these numbers, the total forces of the coalition amount to 445,000.

The Grand Army concentrated about Boulogne, including Augereau's corps stationed at Brest, amounted to 150,000.

Massena commanded about 70,000 in Italy.

A conscription of 80,000 was to keep these two armies complete.

The Elector of Bavaria furnished 25,000.

The total force of the French appears to be 325,000.

The theatre of war is that given as Example 2, in the chapter of Definitions.

The distance from Brody to Braunau on the Inn is 691 miles; that from Boulogne to Braunau, 666 miles; but the Russians might have marched more than the difference of the distances before Napoleon could have heard of their entrance into Austria. It was, in fact, perfectly optional to the Coalition whether war should be declared before Napoleon could hear of this entrance, or the entrance itself be simultaneous with the declaration. Hence, it is clear that before the commencement of the war, the Austro-Russian armies were on interior lines, and it was their own fault if ordinary precautions were not taken to remain so.

The campaign began by an army of 100,000 men under the Archduke Charles, marching on Italy, and another of 85,000 under Mack, and the Archduke Ferdinand marching into Bavaria across the Inn, the Iser, and the Lech, towards the Iller.

The disposition of the forces when Napoleon heard of the commencement of hostilities was as follows:—

Mack and the Archduke Ferdinand were about the Iser.

The Archduke Charles was advancing on Italy and was about the Tagliamento.

The Archduke John was occupying the Tyrol with 40,000 men.

The Russian armies were still very distant. The first Russian army did not arrive at Lintz till Oct. 9, and at Braunau till Oct. 20.

The Grand Army was at Boulogne.

Augereau's corps-d'armée at Brest.

Massena was occupying Italy.

In 24 hours the army at Boulogne had made a half turn to the right, the post was stopped, and the columns had proceeded by forced marches towards the Rhine for six days before it was known at Paris that they had left Boulogne.

Sept. 26. The army of Mack was on the Iller from Ulm to Memmingen.

The Grand Army was on the Rhine.

Napoleon, learning the position of the enemy's forces on the Iller, appointed the strategical lines given as the example to the Definition 8, to conduct the several corps-d'armées from the Rhine to the primary objective, which was a base of manœuvres formed by the line of the Danube from Dillingen to Ingoldstadt. The names of the corps and times of departure from the Rhine will also be found.

In consequence of a demonstration against Stuttgard, the capital of Wurtembourg, made by Ney, who obtained admittance by placing some batteries for the purpose of firing at the gates, together with other considerations, the Elector furnished 8000 troops.

The Elector of Baden furnished 4000.

These 12,000 men took no active part in the campaign, but guarded the communications.

Massena, with 50,000, was ordered on the high Adige to defend Italy against the 100,000 under the Archduke Charles.

Oct. 6.—The strategical front of the French extended along the Danube, from Dillingen to Ingoldstadt. Mack and the Archduke Ferdinand evidently comprehending nothing of the combination in course of developement against them, thought to do the best thing possible in making front to the Danube, Accordingly,

Oct. 6.—The strategical front of the Austrians extended along the right bank of the Danube from Ulm to Rain, the left being under the cannon of Ulm, the centre about Gunzbourg, and the right between Wertingen and Rain.

Obs.—A very strong analogy exists between these operations about Ulm and those in the Marengo campaign before the battle of Alexandria.

The Austrian strategical lines (or lines of retreat), Map 1, running along the line of the Danube are parallel to the Austrian lines along the Po.

The French strategical lines before Ulm are also almost parallel to the French lines before Marengo.

The French base of manœuvres on the Danube, from Dillingen to Ingoldstadt, is the French base from St. Cypriano to Nocetto.

Valence and Alexandria answer to Ulm.

The Bormida answers in a much less degree to the Iller.

We see that the strategical front of the French extends nineteen miles beyond the extremity of that of the Austrians, in the direction towards the Austrian base of operations. It must be remarked how much more the position of the French menaces the communications of the Austrians, than the Austrian position does the French. The French strategical front is nearly perpendicular to its communications with Spire, Manheim, and Mayence, while that of the Austrians is nearly parallel to its communications with Vienna.

The attainment of these positions was all that Napoleon aimed at in the combination he made before leaving France, on learning the position of the enemy on the Iller, and, unless the Russian army arrived in time, insured almost to a certainty the destruction of the army of Mack.

Let us leave the armies in these positions to consider how far this first combination of the campaign was in accordance with the Principles.

It is needless to remark that the armies remained a very short time indeed on these strategical fronts, for Napoleon was not the man to allow the enemy time to get out of his disastrous position, either by good luck or a wise exercise of intelligence ; but, in accordance with his Maxim 4, lost not a moment in deriving those advantages from his position which a vigorous application of the principles of war, in a new combination, insured to him.

This first combination of the campaign was as much as possible in accordance with the Principles.

For the rate at which the columns began instantly to move from Boulogne and Brest to the Rhine by forced marches, and thence to the primary objective as soon as Napoleon learned that an Austrian army had arrived on the Inn, and was moving towards the Iller without waiting for the Russians, shows that it was Napoleon's object to destroy this army, if possible, before the Russians could arrive. This was to introduce Principle 1 as much as possible into the combination.

The choice of so large a strategical front on the Rhine and Mayn indicated an intention of applying Principle 3 in the most perfect manner, by having the largest strategical front consistently with the application of the principle, in order to keep the enemy as long as possible in ignorance of the point on which it is intended to strike a decisive blow.

The French army was on the Rhine when Napoleon heard of the occupation of the line of the Iller by the army of Mack, and, since he chose strategical lines, four at least of which are perpendicular to the line of the Danube from Ulm to Ingoldstadt, which line there can be no doubt he, from the first moment he heard the army of Mack was on the Iller, *intended* to use as a base of manœuvres, perpendicular to his own communications, but parallel to those of the enemy, the Principle 2 was as much as possible involved in the combination.

The successful introduction of Principle 3 in the most perfect manner into the combination was completed by the simultaneous arrival of sufficient columns at the place of assemblement, from the very large strategical front on the Rhine.

This combination, then, is a perfect application of the three principles of strategy, and ought, therefore, provided the data upon which it was constructed did not change, *i. e.*, if the Austrians kept the line of the Iller (for they had ample opportunities of retreating to join the Russian army) till Napoleon could occupy the base from Dillingen to Ingoldstadt, to lead to the most splendid results.

The passage of Lannes and Murat, at Kehl, threatening the Black Forest, served to make the enemy believe that an attack in front was intended.

Obs.—This passage of Lannes and Murat presents an analogy with the manœuvres executed by Augereau and Thureau in the campaigns of Jena and Marengo respectively.

It may be remarked, that the occupation of the line of the Iller, by Mack and Ferdinand, was an absurdity, opposed utterly and equally by all the principles of war. If they did not know of the approach of the Grand Army, they were inexcusably and wonderfully ignorant, for, says Jomini, "every one else knew it."

Before proceeding with the campaign, an objection must be anticipated. It may be said that Napoleon's combination does not appear to offer any reason or remedy why the Archduke Charles should not be able to make Principle 1 tell as much against Massena as Napoleon could the same principle against Mack, and hence that Napoleon's combination made with respect to Massena, before he was certain of having Principle 2 so much in his favour at Ulm, was faulty.

The difference between the cases will be seen from the following reasons or facts:—

1. Massena was on his base of operations, viz., the Adige and Mincio; Mack was 150 miles distant from his.

2. Mack was in a country in which he possessed two or three fortresses at most; Massena was in a country of which he possessed all the numerous fortresses, and occupied them by troops not included in his army of 50,000.

3. Mack was in an enemy's country; Massena was in a country of which not only the government, but the population also, was very friendly.

4. Mack embarrassed with the Archduke Ferdinand, was not nearly so well able to cope with Napoleon, as Massena, with a discretionary power held in accordance with Maxim 5, and the advantage of Napoleon's instructions, was with the Archduke Charles.

5. The army of Massena was more powerful numerically, and much more so morally, relatively to that of the Archduke, than that of Mack to the army under Napoleon.

6. On reading Massena's instructions, it will be seen that he had the power of receiving battle in a very advantageous fortified position, from which, to a very great probability the Archduke would think it necessary to drive him before advancing.

7. If Massena were beaten, contrary to all probability, he could retreat past a sufficient number of fortified places to weaken the Archduke into inferiority by detachments.

As a sort of measure of the speed of the columns, Davoust marched the 140 miles from Manheim to Neubourg at the rate of 15 miles a day.

To continue the campaign:—

October 6.—Soult forces possession of the bridge of Donauvert.

October 7.—Murat and Soult pass to the right bank at Donauvert; Davoust and Marmont pass at Neubourg.

Soult has for strategical line of manœuvres the road from Donauvert to Augsbourg.

Murat, the road from Donauvert to Rain.

Marmont, the road from Neubourg to Augsbourg.

Davoust, the road from Neubourg, by Aichach, to Munich.

Bernadotte crosses at Ingoldstadt, and has the direct road thence to Munich.

Ney, reinforced with two divisions, having in all 40,000, has the road from Donauvert, along the left bank of the Danube, by Dillingen, to Elchingen.

Ney's line of manœuvres was given in accordance with all three Principles; his orders were to obtain possession of all the bridges as he went along, and block up the road to Nordlingen:—With Principle 1, because, the bulk of the Austrian army being on the right bank of the Danube, Ney, marching on the left with 40,000, and opening the bridges as he went so as to lay open his communications with Lannes and Murat on the right bank, would, to a high probability, fall in with fractions less than his own. Lannes and Murat, as will be seen afterwards, took a new line of Manœuvres as soon as the object to be obtained by the line already given was satisfied, and advanced along the right bank towards Ulm, almost simultaneously with the advance of Ney along the left. If by any chance the Austrian generals discovered the only way of getting out of their difficulty, and leaving 4000 men in Ulm, attacked Ney on the left bank, he would have the bridges of Dillingen, Gunzbourg, Leipheim, and Elchingen open, by which numbers might be made to turn in his favour before mischief could take place. In accordance with Principle 2, because the great object of it was to cut the enemy from his line of retreat by Nordlingen into Bohemia. With Principle 3, for by opening the bridges the French were at all times in a position to bring the bulk of their forces on any point which might become a point of collision.

The lines of manœuvres of Soult and Marmont, Murat and Lannes, Davoust and Bernadotte, were taken also in accordance with all the Principles.

For not only do they all satisfy 2 by their direction right across the enemy's communications with Vienna, but

Those of Soult and Marmont cut the right of the enemy, under Kienmayer (it being remembered that the Austrians' strategical front extended to Rain), from the rest of the army.

Davoust's line crosses the piece of ground on which the separated wing must be.

Murat's line on Rain was for the purpose of clearing away any portion of this corps which might remain near the Danube. Murat forced the passage of the Aicha, and Kienmayer retreated.

Hence Principles 1, 3, were satisfied by these lines, for a fraction of the enemy was separated from the main body, and driven before overwhelming numbers past Munich.

The lines of Davoust and Bernadotte extended to Munich, to pursue Kienmayer and hold the Russian army in check.

October 9.—The Russian army arrives at Lintz.

Obs.—At this time 120,000 men were on Archduke Ferdinand's direct communications, *i. e.*, those towards Vienna.

To take up the lines of manœuvres of Soult, Murat, Marmont, Lannes, at the points they were left, or rather to give their new strategical lines of manœuvres, for when they had arrived at those points the little combination for isolating Kienmayer, supplementary to the great combination for isolating and surrounding the whole army, had attained its object, and so the corps engaged in it may be considered to have new lines :—

Murat and Lannes remount the right bank, and go by Wertingen, Zusmershausen, and Gunzbourg, to Ulm.

Marmont goes to Zusmershausen, where he joins Lannes, Murat, and Napoleon, and goes on with him to Ulm.

Soult goes by Landsberg to Memmingen, thence to Biberach,

This new line was assigned to Lannes, Murat, and Marmont, in accordance with all the three Principles.

Because it had for object to divide the greater part of the army which was about Ulm from the rest towards Memmingen. The bulk of the army being about Ulm, the direction of this line on Ulm, is the most advantageous possible, because the nearer the line passes Ulm, the greater the portion of the enemy which is cut from the main body. Again, because Marmont marched from Augsbourg to Ulm, Lannes and Murat from Zusmershausen to Ulm, along the principal communication of the enemy with Vienna. Also because it brought Lannes, Murat, and Marmont into close communication with Ney, whose line, it will be remembered, ran along the left bank, and who was to take possession of the bridges when Ney was attacking the bridge of Gunzbourg ; Murat was at Burgau, assisting him, threatening to take the enemy in reverse.

While *en route*, Murat and Lannes met at Wertingen with twelve battalions which Mack had sent to the succour of what was his extreme right, under Kienmayer. This corps was dispersed, and 3000 prisoners taken. It may be remarked that Murat's line compelled Mack to retire from Burgau as it menaced his communications with Ulm.

Soult's line was assigned:—

1. To intercept and destroy the portion of the enemy stationed at Memmingen, and all those intercepted from the main body by the march of Lannes, Murat, and Marmont.

2. To cut the enemy from his communications by Memmingen and Biberach with the Tyrol (the Tyrol belonged to Austria.)

October 9.—Soult arrived at Augsbourg; on the 11th he arrived at Landsberg, and fell in with Archduke Ferdinand's cuirassiers furnished with six pieces of cannon. The 26th Regiment of chasseurs-à-cheval attacked them, took 120 of them prisoners and two cannons.

October 13.—The General Spargen, who commanded 7000 men in Memmingen, laid down his arms, and Soult immediately proceeded to stop up the road by Biberach.

The result of the pursuit of Kienmayer by Davoust and Bernadotte was, that he was driven beyond the Inn, with the loss of 2000 prisoners.

October 10.—The position of the French was as follows:—Ney was at Elchingen, cutting off by his position the enemy from the road to Nordlingen, by which he might have escaped into Bohemia; Murat, Lannes, and Marmont were masking Ulm, on the right bank of the Danube; Soult was on the road from Augsbourg to Landsberg; Davoust at Augsbourg; Bernadotte at Ingoldstadt. Napoleon seeing affairs in this state, and thinking that with the 100,000 men left at Ulm it was no very difficult matter to invest it, leaves for Augsbourg to join Davoust, intending to proceed with him to Munich. This determination was motived by fear of the approach of the Russians. Faithful to the Maxims 4 and 5 with regard to unity in the command, Napoleon appointed Murat to the command of the whole army at Ulm. When Napoleon was gone, Murat, who appears to have been in equal ignorance of the motives of Ney's instructions, the general object of the operations, and the most ordinary principles and maxims of war, orders Ney to cross to the right bank at Elchingen, and proceed to Witlingen.

This, as the reader will see at a glance, was to throw the French communications as completely as possible at the mercy of the enemy, who might leave 4000 men to Garrison Ulm, march on the French communications, manœuvre on them as long as he might deem expedient, either taking possession of and defending the bridges of Elchingen, Leipheim, Gunzbourg, &c. and the important points of the communications generally, till the arrival of the Russian army; or, if pressed closely, decamp, after doing immense mischief, by his line of retreat by Nordlingen to Bohemia. In this case, if Mack had succeeded in maintaining himself on the left bank till the Russian army, having crossed at Ratisbonne, joined him on the French communications, having opened his own communications with Bohemia, the war ought to have taken a very different turn from what it did. Ney refused to obey Murat's order completely, alleging that the enemy would escape by Nordlingen, and left behind him on the left bank the divisions Dupont and Barraguay d'Hilliers. Barraguay d'Hilliers was ordered by Ney to join Dupont at Albeck; he, however, acted singularly, remained stationary, and did nothing. Mack sent 20,000 men, under the Archduke Ferdinand, along the road to Nordlingen, intending, no doubt, to follow with the rest of the enemy.

October 11.—Dupont, with his division of 7000 men, fell in with these 20,000 at the village of Haslock, on the road from Albeck to Ulm. Here Dupont and his division, composed of the élite of the veterans of Italy, covered themselves with glory by stopping a movement which involved the escape of the enemy, and loss of all the preceding operations. Dupont triumphed owing to the adoption of very exterior tactical lines by the enemy; he maintained himself till night, and before day break retreated on Albeck with 3000 prisoners.

Ney, in order that Dupont might not be compromised by being left alone on the left bank, ordered him to retreat, and the French communications were completely exposed.

In this state of affairs, Mack, hearing that Spargen was attacked by Soult, sends Jallachich to succour him, having sent Werneck and the Archduke Ferdinand towards Heydenheim to pursue Dupont. Jomini stigmatizes this proceeding as the most absurd possible.

To consider and judge it by means of the principles:—Memmingen being 28 miles from Ulm, the sending a detachment to that place was completely contrary to Principle 1, because Lannes, Murat, and Marmont having at least 70,000 men near Ulm, in the angle on the right bank of the Iller, this detachment was almost sure, before it got half way to Memmingen, to be brought into collision with a body double or treble in own size.

It was contrary to 2, because this principle required most imperatively that Mack should secure the only communications he had left, the road by Nordlingen to Bohemia, and that he should by no means lose so fine an opportunity of operating on the French communications, and perhaps of effecting on them a junction with the Russians.

It was contrary to 3, because it admitted a larger body than even his main body in a direct line between the main body and the detachment.

The sending Werneck to Heydenheim was not wrong, it was the sending a detachment to Memmingen which was wrong.

On the 13th two Austrian divisions, amounting to 15,000 were sent with 40 pieces of Artillery along the left bank to take possession of the bridge of Elchingen, and defend the passage of the bridge by occupying the heights of Elchingen.

Their advanced guard easily drove the single regiment which protected the bridge on to the right bank. General Macher, in command of the regiment, broke one of the arches to protect himself against such superior forces.

Ney, who saw everything happening just as he had predicted to Murat, took two divisions for the purpose of retaking the bridge, and returning, if possible, to the very position of which he had quiet possession three days before.

The Austrians whose object was to prevent the French from passing the bridge, endeavoured to burn the remaining arches, and succeeded partially. Ney ordered the bridge to be repaired, and disposed every thing for forcing the passage on the 14th, so that Napoleon on his arrival found all possible measures taken to remedy the mischief caused by Murat.

It is to be remarked, that Murat's ignorance allowed Mack from the 11th to the 13th, three days and three nights, at any time during which he might have effected his retreat by the road to Nordlingen, thus saving his country 50,000 good troops at least, every one of whom were lost, as the sequel will show. With 150,000 men on his communications with Vienna,—for after Ney had passed, the number on the right bank amounted to that,—and a safe line of retreat open by Nordlingen or Bohemia, and with perfect liberty to leave a sufficient garrison in Ulm, it is difficult to conceive what motives could have induced Mack and Ferdinand to allow the army to wait three days and three nights at Ulm, while the circle of investment was again repaired and perfected.

On the 14th, Ney (afterwards Duke of Elchingen) crosses the bridge, and attacking the very formidable position taken up by the enemy, defended by 40 pieces of Artillery, defeats and drives away the enemy. Ney, who had just finished a smart quarrel with Murat, as if to defy the latter to a contest of valour, dressed himself in full uniform (like Nelson at Trafalgar), and putting himself at the head of the column, crossed the bridge; and, directing every battalion of the column, was present wherever the danger was the greatest; he seemed to seek death; death wanted him not. *(Jomini vié de Napoléon.)*

The position resulting from the battle of Elchingen:—Soult and Marmont invested Ulm or. the right bank, the former approaching by the road from Biberach. On the left bank the position of the Austrians was such, that they appeared to have come from France; in addition, their army was divided into two parts: the one under Mack took refuge in Ulm: the other, under Ferdinand and Werneck, endeavoured to escape by the road to Nordlingen.

Oct. 16.—Murat and Dupont attacked the rear guard of Werneck at Langenau, overthrew it immediately, and took 2000 prisoners. The main body of Werneck and Ferdinand were attacked on the 8th, at Trochtelfing, near Nordlingen, and overthrown, with the loss of 8000 prisoners. A great convoy was taken the same day by a brigade of dragoons, at Bopfingen.

Oct. 19.—In consequence of the surrender of Ulm, 30,000 Austrians, with 16 generals, laid down their arms; and with the exception of officers above the grade of captain, who were allowed to go home on their parole not to bear arms again during the war, were sent prisoners to France. Among the trophies were 40 standards, 60 pieces of Artillery, and 3000 Cavalry horses. Of all the 85,000 men under Mack, a portion of the corps of Kienmayer and 2000 cavalry under Ferdinand alone escaped.

To sketch the remainder of the campaign:—

Oct. 23.—The army leaves the Iller for Vienna, the line of operation being the one given as an example to the definition, Two corps skirt the mountains on the south of the line of operations, in order to turn the great rivers, viz., the Inn, the Salza, the Traun, and the Enns. The other Corps follow the high roads for Vienna on the right bank as far as Lintz.

Oct. 31.—The French attacked the rear-guard of the Russians, at Lambach, on the Traun; after an obstinate resistance the Russians were overthrown, with considerable loss.

At Lintz, Mortier was detached with 20,000 men to the left bank across the excellent bridges, in order by menacing the Russian communications with Moravia and taking their positions in reverse, to prevent them from defending the strong lines of the great rivers which cross the line of operations.

Napoleon expected that the Russians would defend the strong position in the mountains at St. Polten, and sent Davoust by Mariarell and Silienfield to turn the position. The Russians however, did not defend it.

Nov. 8.—Davoust, after passing the mountains between St. Gaming and Mariarell fell in with the columns of Merfeld, which were marching by the road from Molk to Lesben.

Davoust attacked the column, divided it in two, drove back one part to Neuhaus, and made 3000 men lay down their arms; the remains of the column gained Neustadt in the greatest confusion.

Nov. 9.—Kutusof, with the Prussians to lessen the severity of the pursuit, crossed the Danube, at Mantern, on an excellent wooden bridge of 28 arches, the only one between Lintz and Vienna, and burned it after him.

Mortier, eager to overthrow the Russians as they should cross to his side, pushed on somewhat imprudently with one division and a brigade of dragoons; he was followed at the distance of a march by Dupont's division, and this at a still greater interval by a Dutch corps. Mortier, after passing Durrenstein, fell in with and drove back the Russian advanced guard to the gates of Stein; this nearly led to a misfortune (an event not very unlikely, *à priori*, from the construction of the French column of march), for Doctorof, with a Russian Division, descending from the mountains, shut Mortier up in the defile, while the advanced guard was reinforced in front of him. Mortier determined to cut his way out, which he was doing with tolerable success, when Dupont, arriving on Doctorof's rear, put him in the same position in which he had placed Mortier. Doctorof escaped over the mountains, by the ravine by which he had come. Mortier and Dupont then turned their efforts on the remaining Russian corps. Mortier repassed the river at Spitz.

Nov. 13.—Murat and Lannes arrive at Vienna, and take possession of the bridge.

Nov. 14.—Napoleon and Soult arrive at Vienna, Davoust also arrives about the same time.

Kutusof, who it will be remembered crossed at Mantern, hearing of the passage of the Danube by Lannes, Murat, and Soult, finds it impossible to prevent being intercepted at Znaim without a combat; he therefore detaches Bagration with 9000 men to take a position at Hollabrun, and hold it to the utmost, while he himself goes direct to Schratenthel. Mortier and Bernadotte cross at Mantern, and pursue Kutusof in his rear.

Nov. 16.—Murat, Lannes, and Soult attack Bagration; kill and take 3000. Sebastian, in the pursuit, takes 1000.

Bagration succeeds in joining Kutusof at Wischan. Napoleon as soon as he receives the news of his combat and the retreat of Kutusof, makes the following disposition of his army:—

Lannes, Murat, and Soult are placed in cantonments between Brunn (an important fortress which had been most unaccountably relinquished to the French,) Austerlitz and Wischan.

Davoust is sent to Presbourg, to act on the courage of the party in Hungary which was favourable to the war.

Bernadotte is sent to Iglan, both to act on the moral of the Moravians and reconnoitre.

Mortier is recalled to occupy Vienna.

Marmont is sent to Lesben, that, by occupying that place and Bruck, he may create a division in favour of Massena (who, it will be remembered, was in Italy with 50,000, opposing the Archduke Charles with 100,000), and to induce Archduke Charles, then retreating, to prefer the longer road through Hungary for effecting his junction with the Russo-Austrian Army, and thus retard the time of the junction, so that the Archduke Charles might not arrive till the Russo-Austrian army had been beaten separately.

To return to the detachments, viz., Massena against Archduke Charles in Italy, and Ney against Archduke John in Tyrol:—

The instructions given to Massena were to take up a position at St. Michel, on the Adige, between the mountains and the river, where the locality would compensate for the difference of numbers; thence to operate on the communications of Charles, if he should act offensively and cross the Adige, leaving Massena in his rear, a proceeding of too bold a character to be expected from him.

Archduke Charles maintained the defensive, and entrenched himself in a strong position at Caldioro, on the road to Vicense from Verona. Here Massena having heard of the surrender of Ulm and advance of the main army, attacked him, and nearly succeeded in obtaining a great success. Evenly balanced success in this battle was succeeded by the retreat of Archduke Charles on Leybach, a proceeding necessitated by the advance of the main French army.

Ney took Innspruck, and compelled the Prince of Rohan, with 7000 infantry and 1000 cavalry, to lay down their arms.

Nov. 15.—The Archduke John, who commanded 40,000 in Tyrol, fearing for his communications, which the retreat of the Archduke Charles on Leybach entirely uncovered, left the Brenner in the night and retreated by Villack and Klagenfurt to Cilli, where he joined Charles, then retreating from Leybach into Hungary.

To give an idea of the speed with which the French marched from the Iller to Vienna, let us take the corps of Davoust.

Davoust left the Iller Oct. 22; then, supposing him to have proceeded by this most direct route to Lintz, and remembering that he made a circuit from this place to Mariarell, thence by Silienfield to Vienna, where he arrived Nov. 14; he had in 22 days marched at least 315 miles. This gives an average rate of from 14 to 15 miles a day, and it will be remembered that Davoust had an engagement at Mariarell, where he took 3000 prisoners. Davoust had also in his strategical line crossed six rivers and the mountains of Mariarell. It is probable that the combats of Amstetten and Krems would to a certain degree retard his march.

To sketch the conclusion of the campaign:—

Nov. 28.—The Russian army leave Olmutz and carry the post of Wischau, which covered the French cantonments.

Murat, Lannes, and Soult receive orders to leave their cantonments between Brunn, Wischau, and Austerlitz, and to assemble before Brunn.

Bernadotte receives the order to leave a single Bavarian division at Inglau and approach Brunn by forced marches.

Mortier receives orders to commit Vienna to the division of Damonceau, and hasten to Brunn.

Marmont is ordered to leave Neustadt and approach Vienna.

Davoust is ordered to hasten to Brunn.

Nov. 29.—The Austro-Russian army marches seven miles from Wischau to the heights of Kœtchrean.

Nov. 30.—The Austro-Russian army bivouacs at Hogreditz.

Dec. 1.—The Austro-Russians placed themselves on the hights of Pratzen in front of the French.

Dec. 2.—The enemy, from an adoption of very exterior tactical lines, experiences the disaster of Austerlitz.

CHAPTER II.

RETREATS.

Jomini says, "Retreats are incontestably the most difficult of the operations of war;" and quotes a saying of the celebrated Prince of Ligne, "That he could not conceive how an army could effect its retreat." According to Napoleon, "Retreats cost more men and material than the most bloody battles; with this difference, that in a battle the enemy loses nearly as much as one self, while in a retreat one loses without his losing."

To see what instructions can be obtained from the Principles of Strategy for the direction of retreats, since retreats, no less than all other strategical operations, must be conducted in accordance with these principles.

The Principles clearly indicate :—

1. That, 1, an army retreating from a point on which it is collected, shall retreat by a single road; if, however, there be several roads parallel to one another, and so near together that the army can move on them consistently with 3, it is best to do so, to avoid encumberment and disorder.

2. That in this case, 1, 3, the army shall retreat in as close a column as possible consistently with an avoidance of encumberment and disorder.

3. That 1, 3, and sometimes 2, if an army be scattered on several points, the division shall retreat on concentric lines towards a common point, so situated that neither of the columns shall risk being attacked separately before all have arrived and formed a single mass at the point.

Leaving the principles, there are six manners of effecting a retreat.

1. To march in a single mass on a single road.

2. To march on a single road in two or three corps, with an interval of a day between them.

3. To march on a single road in two or three corps, with an interval of half a march (about eight miles) or less between them.

4. To march on several parallel roads with a strategical front perpendicular to the roads.

5. To start from two or more different points concentricelly towards a single point.

6. To divide an army collected into a single mass into

several fractions, and retreat excentrically towards several points distant from one another.

With regard to the direction to be given to lines of retreat, very little need necessarily be said.

1. An army retreating by a single line on its base of operations will in general move by the shortest possible line, to avoid allowing the enemy by taking a shorter road to intercept the army, or effect an attack in flank.

2. An army retreating concentrically from several different points towards a single point, will have the direction of the lines determined by the condition already given for determining the point. The remarks on the Jena campaign recommending a concentric retreat on Leipsig may be referred to.

3. An army retreating from its frontier into its own country may either retreat towards the centre of power of the state, generally the capital, or parallel to the frontier (between the two lines of fortified places to be spoken of in the chapter on fortresses,) basing itself on the fortresses and rivers available.

A line of retreat parallel to the frontier is in general preferable, because it prevents the enemy approaching the capital, or centre of power, thus disturbing the organization of the country by striking at its centre. With forces at all equally balanced, it would be absurd for the enemy to approach the centre of the state in the midst of a hostile population, leaving its communications to the mercy of an army on the frontier.

Observations on the six manners of retreating :—

The manner 1 of retreating is preferable for an army which retires, without having been injured, in the intention of fighting, as soon as it has received an expected reinforcement, or when it shall have arrived at some strategical point, because this manner gives the greatest tactical mobility to the army.

Since, 2 and 3, the object of the division of an army retreating on a single road into several corps, is only the avoidance of encumberment, and this advantage is secured to an army not exceeding 150,000, by an interval of half a march, or from seven to eight miles, the system 3 has the advantage of 2 for all armies less than 150,000, and for such, 2 never ought to be used. As the numerical strength of an army diminishes, so the intervals between the corps will proportionally diminish; and for an army less than 120,000, a less interval than half a march must be employed. If an army contain from 120,000 to 150,000, then it may have an arrière-guard of 25,000, the remainder being divided into two equal masses. The two intervals will be eight miles each, or two hours if measured by time. Lateral roads will be made use of when they exist.

The system 4 is preferable to all others when the roads are sufficiently near that the principle of interior lines be not violated, for if the roads do not satisfy this condition, each of the wings separated from the rest of the army may be separately overwhelmed if the enemy, directing the mass of his forces upon it, obliges it to receive battle.

It has been seen, that system 5 is the only one which the principles admit when the army is divided into several corps, separated from one another. There is nothing better to be done than to unite the forces in a single mass, according to the principle, for they are necessarily better able to withstand the enemy when in a single mass than when separated, and the way to unite is to retreat concentrically on a single point.

The system 6 is never to be used except in two extreme cases.

1. When an army has received a violent shock in its own country, and its disorganized divisions go to different fortresses to seek shelter and reorganize.

2. In a national war (*i. e.*, a war in which not only the organized armed force but the whole nation takes part,) when each fraction of the army is to serve as a nucleus for raising a province and form a framework into which recruits are to be put.

Articles and books are to be found,—among others that very extraordinary one in the "Encyclopædia Britannica,"—

to the effect that excentric retreats are the only ones admissible in any case, and that all others are absurd in the face of the matter. These articles and books have been protested against by experience, just so often as the folly or wisdom of a general has chosen an excentric ór concentric retreat.

Let us take a simple case. Suppose that, after a battle, the number of a defeated army, D, is 40,000; that of a conquering army, C, 60,000. Let D retreat excentrically, on four roads, 10,000 taking each road. Let C divide itself into two divisions of 30,000, and pursue the two bodies, of 10,000 on the two extreme right-hand roads of the four. It is clear that by this means, if D continue to retreat excentrically, two engagements will take place, in each of which, C will have 30,000 against 10,000; the result one would suppose to be the complete overthrow of two of D's fractions.

Let now that of C's fractions which is nearest the remaining two of D's divisions, march directly on the nearest division to it, and let the remaining one of C's divisions follow the other as fast as possible. By this means, at the worst, an army of 25,000 at least will be brought against one of D's two remaining divisions of 10,000, for one can hardly suppose that 30,000 in engaging 10,000 would lose 5000; they ought not to lose 3000. The result, if D continue his excentric retreat, is, that another of his divisions will be destroyed by 25,000, &c. What, then, is the only means by which D, beginning to retreat excentrically from a lost field, and continuing that course, can save himself from destruction? Concentration, that is, by a concentric, not an excentric retreat.

The great and grand reason alleged why excentric retreats only are admissible, is that the enemy dare not pursue because he is exposed to an attack in flank, which is considered an insurmountable obstacle to his pursuing. This threatening danger cannot certainly have place after the divisions of D have attained a distance of more than ten miles from the common point, for then each of D's divisions would be sufficiently isolated to be beaten separately before succour could arrive.

In fact when retreating excentrically, what is one doing, if not dividing the army into fractions, and removing them one from the other, expressly to give the enemy an opportunity of bringing the mass of his forces into collision with them successively?

Napoleon's retreat from Leipsig was in a single mass on one road, although the article on war in the "Encyclopædia Britannica" states most positively that a retreat on a single line is in all cases a fault of the utmost magnitude, and that this retreat ought to have been excentric.

The road on which the retreat was executed passes from Leipsig by Naumberg, Erfurt, Gotha, Eisenach, Fulda, Hanau, and Frankfort to Mayence. At Hanau, Napoleon found Wrede with 50,000 men in position across the road barring his passage.

Since the "Encyclopædia Britannica" says, "It is a rule that it is *essentially* necessary, in all retreats, to divide into different columns in order to distract the attention of the enemy, and that there is no more important maxim in war," let one of Euclid's favourite little trains of argument be for a moment indulged in. For, if it be possible, let it be essentially necessary to divide into different columns in all retreats. Therefore Napoleon retreating from Leipsig would have suffered less if he had divided into two or more different columns. Two combats only took place during the retreat: one at Kosen, before it was possible for Napoleon to retreat excentrically, because there were no roads; the other already spoken of at Hanau. Hence a column of march of half his army, at most, would have suffered less from finding Wrede with 50,000 barring its passage than the column of march of the whole army. Therefore half an army is stronger than the whole, a whole less than a part, which is absurd. Hence it is not essentially necessary, &c.—Q. E. D.

The retreat of Moreau, in 1796,— one of the best and most successful of the operations directed by this general,— may be taken as an example of a concentric retreat. At the commencement of this retreat, Moreau, who had, during the latter part of the campaign, been rivalling the Austrian general as to who should have the longest strategical front, found himself on a very long one from Eichstedt, near Ingoldstadt, on the left bank of the Danube, to Frieberg, near Augsburg, on the right, a distance of 40 miles at least. Moreau retreated concentrically from all parts of his front till the whole army was united in a single mass about Lake Federsee, near Biberach. Here he signally defeated the enemy, who, inferior in number, had the imprudence to put himself on a very disadvantageous tactical front, in face of Moreau on one very advantageous. This facilitated the retreat greatly, by overthrowing the enemy who was pursuing him in rear. From the Federsee, Moreau goes in a single mass by Moskirch to Stockach. Here the packs and baggage leave the army and take the road by Schaffhausen and Waldshutt, along the Rhine to Hunningue, when they cross. Moreau, in all haste, fearing the advance of the Archduke Charles on his right flank, finding the road through the valley of the Kruzag occupied by the enemy, decides on passing by Neustadt through the Val d'Enfer to Frieburg, whence he intended proceeding to Strasbourg. The Archduke arrived too soon, and Moreau retreated by Schliengen to Hunningue, where he crossed the Rhine. The concentric retreat of the Russian armies before Napoleon, in 1812, was one of the first causes of his misfortunes. The following sketch is given to shew the concentric lines on which the Russian armies retreated. The Russian general, Barclay, evidently desired, during the whole of the retreat on Smolensk, to unite his own army with that of Bagration, the armies having been separated by Napoleon's march on Wilna. The following extended strategical front of the Russian Army led to the separation of Barclay and Bagration. The army of Barclay, consisting of 130,000 men, extended from Lida to Kosiany behind the Niemen. Bagration, with 60,000, was in the neighbourhood of Wolkowisk, in the interval between the Niemen and Narew. Tonnasoff was in the environs of Soutsk behind the Bug.

This disposition was met by the following combination on the part of Napoleon for dividing the Russian army. Napoleon, with 220,000, advances on the road from Trochy to Wilna, thus dividing the left of the army of Barclay under Doctorof, from the rest, and the army of Bagration completely from Barclay.

The Viceroy (Eugene) is sent with 60,000 to march on a line intermediate to the lines of retreat of Barclay and Bagration, to prevent their concentration.

Jerome is sent with 70,000 to pursue Bagration.

Barclay passes the Wilna, burns the immense magazines which had been amassed at a vast expense, and retreats by Nementschen and Swenziany to Drissa, with the intention of concentrating his left, and Bagration,—in fact, the two whole armies,—at the fortified camp, which had been prepared at immense expense and labour.

Barclay sends Bagration the order to retreat by Slonin and Wileika to Drissa; this, however, Bagration finds it from the first impossible to obey, since the French were already between.

Doctorof also receives orders to retreat on Drissa, where he succeeds in joining Barclay.

First, to trace the line of retreat of Barclay on Smolensk. Napoleon marches towards Polotzk, intending to take the roads thence to Drissa, thus cutting Barclay from his communications with Smolensk, overthrowing him and driving his remains towards the Baltic.

Barclay, however, was retreating on Witepsk, and had arrived at Polotzk, at the same time Napoleon arrived at Glubokoe.

Napoleon now tries to intercept Barclay at Witepsk, but in this also he fails, and Barclay escapes by Roudnia to Smolensk.

Next, to trace the line of retreat of Bagration from Wolkowisk on Smolensk.

Consistently with his orders, Bagration tries to retreat by Nowogrodesk and Neslayeff on Wileika, in order, if possible, to join Barclay at the fortified camp; this, however, is impossible, in consequence of Jerome being already between. Bagration, in consequence, goes to Mir, whence he tries to reach Minsk by Kardanow, still endeavouring to make the retreat concentric; again intercepted, he retires to Neswije. Thence he proceeds by Glutsk, and Bobrisk, and Novi Bychow, to Mohilew. Being repulsed by Davoust at Mohilew, he returns to Novi Bychow, where he crosses the Dnieper, and thence by Mestislawl to Smolensk, where he joins Barclay.

From Smolensk, Barclay and Bagration proceeded together along the great road by Dorogobusch and Wiasma to Moscow.

This concentric retreat gave the power of fighting an insufficiently decisive battle on the Moskwa, and, as well, kept together and brought into the right position an army so strong that, when placed at Tarontina, menacing offensively Napoleon's single communication, he dared not attack it. This concentric retreat, according to Jomini, was one of the first causes of Napoleon's misfortunes.

As an example of the absurdity of excentric retreats, that of Wurmser before General Buonaparte, after Roverbella, may be read.

This allows a brief sketch.

Wurmser, arriving in Italy with a reinforcement of 20,000 picked men, beats back the divisions of Saaret and Massena. Buonaparte concentrates his forces between Beschiera and Goits, and, though he had only 40,000 men, defeated 60,000, because the enemy suffered him to engage with only one of their columns at a time.

Had Buonaparte retreated excentrically when he found himself with 40,000 in face of 60,000, after the retreat of his first divisions, what would have become of his conquests? Wurmser now retreats in his turn, and as excentrically as any one could wish, on the two extremities of his line of defence. Buonaparte as a matter of course, directed his whole mass first on one of these divisions and overthrew it, though favored by the mountains of Tyrol, at Trent; then throwing his whole mass, in turn, on the communications and rear of the other division, destroyed it in its turn at Bassano and Mantua.

As an example of a line of retreat, very wisely directed along a frontier, and otherwise exceedingly honourable to all concerned in it, we may take that of Soult from Villafranca to Toulouse. Soult opposed the passage of the Bidassoa, Oct. 7. The line of retreat may be taken to commence at Villafranca, and passes by Bayonne, Peyrehorade, Orthes, Tarbes, to Toulouse, when it was put an end to by the abication of Napoleon.

ON PURSUITS.

The general principles for the conduct of a pursuit are not very satisfactory.

1. It is in general more advantageous to attack the retreating columns in flank than in rear, especially when one is able to take a direction making a large angle with an even perpendicular to the line of retreat. It is, however, necessary to beware of extended movements for this purpose, for fear of losing the trace of the enemy.

2. It is in general best to pursue with the utmost audacity, vigour, and activity.

3. An Army possessing a decided superiority may take up a position barring entirely the path of the retreating army. If, however, the superiority is not considerable, it is better to attack in flank, even where it is possible to obtain a sufficient advance to intercept.

In applying the general principles to pursuits, the principle need not be so much regarded in one respect as before the retreat commences. Thus, supposing an army A to advance in three equal fractions, distant from one another, against an army B, and suppose the relative forces of the armies to be such that it is expedient for B to remain concentrated in a single mass and march against one of the fractions. Then it may be that, if A were retreating from B, it would be most expedient for B to divide into two masses to attack two of the three masses of A, because the moral of an army being in general much affected by a retreat, and also for other reasons, it is not requisite that the pursuing party should have so large a numerical superiority. The game between the advanced guard of a pursuing and the rear-guard of a retreating army being very favourable to the former, it is desirable that it should be played along as great a front as possible, and to multiply the number of pursuing columns is to extend this front; an additional reason, by the way, for not retreating excentrically on several roads.

One of Napoleon's greatest faults appears to have been too great a tendency to divide his army in pursuing; in other words, he paid too little attention to Principle 1 in the construction of his pursuits. A notable instance of this tendency took place during his retreat on Paris, before the allies, in 1814—a retreat in other respects a model of the concentric order.

After a temporary success in the course of his retreat, Napoleon separated his little army into three columns, to pursue on the three different routes, instead of remaining in a single column and pursuing on the left of the enemy only.

One of the most necessary precautions for ensuring the success of a retreat, is to impress the soldiers and officers with the fact that they run no more risk in fighting an enemy who attacks the rear of the column, than one who attacks the front.

They ought also to be well impressed with the fact, that the maintenance of order is the only safe guard for a retreating army.

The Marshal Ney is a model of all that can be desired in a general of rear-guard. Ney commanded the rear-guard in the retreat from Moscow, when his extraordinary courage and fortitude covered him with the admiration of the army, who unanimously declared him the most intrepid of its chiefs, and with a glory as lasting as the world itself.

When one is too much pressed, it is sometimes advantageous to turn suddenly and attack the enemy vigorously, as the Archduke Charles did at Neresheim, Moreau at Biberach, and Kleber at Ukerath.

As an example of a pursuit directed on the flank of the retreating column, that by the Russian army after the burning of Moscow may be taken.

The concentric retreat of Barclay and Bagration having allowed the Russians to place an army at Tarontina, while Napoleon was at Moscow in an offensive position, menacing his line of retreat, the pursuit took place along a line running by the side of the French line of retreat, thus threatening their left flank.

The French line of retreat from Moscow was by Borousk, Majaisk, Wiasma, Smolensk, and Orscha. The line of pursuit was taken by Jonknow, Jelnia, and Jourovo, to Krasnor, when the Russians, turning to the right, fell on the flank of a French column, and succeeded in dividing it. The three disastrous days of Krasnor were the result.

The pursuit of the Prussians by the French after Jena is a model of pursuit in regard to the vigour, activity, and audacity displayed.

ON FORTRESSES.

The subject of fortresses divides itself into two parts :—

The manner of forming a system of fortresses for the defence of a country.

The effect of fortresses in retarding the operations of an enemy, and the way in which the enemy's fortresses are to be treated in strategical operations.

PART 1.

The objects to be had in view in the formation of the system of fortresses for the defence of a country are—

1. To defend the frontiers.

2. To facilitate the operations of an army in campaign defending the country against an invading army which has passed the frontier.

The subject will be divided as follows:—

1. Considerations on the defence of a frontier by means of fortresses.

2. To determine the point which strategy and tactics indicate as most favourable for the placement of fortresses.

3. The choice of the particular points on which the fortresses of a State are to be built.

1. Unless a line of country be covered by great natural obstacles, such as a high chain of mountains, it is evidently impossible to compel an enemy to attack a fortress in order to pass it. The impossibility of multiplying fortresses on an ordinary frontier to a sufficient extent to compel the enemy to attack a fortress in order to pass, is evident from the consideration that, allowing three fortresses only to every 180 miles of frontier, the frontiers of France would take 35 fortresses, a number which, with the fortresses of the interior, which are of equal importance to facilitate, in conjunction with those on the frontier, the operations of an army in compaign opposing an invader who has crossed the frontier, becomes almost excessive, and it is evident that an enemy can penetrate between places 60 miles apart.

When a frontier is covered by a continuous line of extraordinary natural obstacles, it is possible to cover it very completely by a system of fortifications, but experience goes to show that no line can be rendered impregnable.

The difficulty of rendering a line impregnable arises from two causes: the forts capable of being built in the gorges and passes are capable of being taken; an enterprising enemy will always find some path practicable which was not before considered so.

EXAMPLES ILLUSTRATIVE OF THE PRECEDING STATEMENTS.

The passage of the Maritime Alps under Francis the First, when, by crossing the steep rocks between Mount Cenis and the Valley of Queyras, he succeeded in falling on the rear of the enemy, who was encamped at Sure. The passage of the St. Bernard and the defile of Bard. The three passages, or rather crossings of a line, which Lloyd had before pronounced impregnable, viz., that formed (Map 1) by the Inn with its contiguous mountains and the Danube from Passau to Ratisbonne, with the southern mountains of Bohemia. Lloyd compares this line to two impregnable bastions, whose curtain, formed by the three excellent fortresses of Passau, Braunau, and Salzbourg, has for its ditch one of the most impetuous rivers of Europe. The passage of the Sommo Sierra, defended by 10,000 Spaniards, 1808. This passage was one of the most extraordinary feats of arms in the wars of Napoleon.

It is then by no means certain that, even with the advantages of the line of extraordinary natural obstacles, the enemy will be obliged to attack a fortress in order to pass.

In the days of Eugene and Marlborough, and even till the wars of the French revolution, armies turned aside from their march to seek for fortresses and entrenched positions, that they might wait before them and waste their strength against them. Scholars experience wonder at the immense labours undertaken by Cæsar to invest Alisa. Metz singly opposed the whole power of Charles the Fifth. Lille suspended for a whole year the operations of Eugene and Marlborough. We are already far from those days.

To determine the points which strategy and tactics indicate as most favourable for the placement of fortresses.

It is evident that strategy indicates the strategical decisive points of a country, all of which are enumerated and classed in Chapter I., as the points on which fortresses are to be placed. And obviously the higher the order of a strategical decisive point, the better it is for the position of a fortress. Sufficient examples have been given in Chapter I., and, from what has there been said, the student may take a map and recognise readily the great majority of the most important decisive points in a country, *i. e.*, the great majority of the points which strategy indicates as most important for the placement of fortresses.

OBSERVATION ON DECISIVE STRATEGICAL POINTS OF CLASS 7.

A certain number of decisive points will be chosen from considering the great strategical combinations which the configuration of the ground offers, in the case of a war, to those of the neighbouring countries of sufficient importance to be taken into consideration. When it is found that a country possesses roads which have a direction and situation such as to facilitate in an extraordinary degree the principal offensive strategical combinations of an enemy, fortresses must be placed on their important decisive strategical point or points.

As examples of such roads, the three roads leading northwards from Coberg and Bamberg already mentioned in the sketch of the Jena campaign, and the road from Perpignan to Barcelona, may be taken.

Certain points then become important strategical points from the considerations of the most remarkable strategical combinations which the configuration of the ground and the principles of strategy offer to an enemy, and on such, since they are important strategical points, fortresses are to be placed.

A fortress having a bad strategical situation is as great an evil as one well situated is a good. It is an evil to the army, which is made to weaken itself in order to garrison it, and an evil to the State which expends its money and soldiers in pure loss. If a fortress be not on a decisive strategical point, it will be, as many of the fortresses of Europe actually are, an evil to the State which possesses it, for, having no strategical position, no army will go out of its way to attack it.

That which tactics requires of the configuration of the ground on which a fortress is to be placed is—

1. That the ground be such that the fortress shall not be commanded by any heights.

2. That the roads and outlets shall be more favourable to an army fighting with its back to the fortress, than to the enemy.

3. That the slopes of the eminence on which the fortress is situated be not too steep, so that the Artillery may have its full effect.

The second of these conditions alone requires a reason. If the outlets of a fortress are not more favourable for a sortie, than for the enemy in opposing a sortie, it may be, and has happened, that a smaller number of men, profiting by the nature of the outlets, blockade a greater number within the walls.

On the choice of the particular points on which the fortresses of a State are to be built:—

In order to determine the best system of fortresses, it is manifest that all points of each of the kinds just specified must be picked out on the map, and each pass under mature consideration.

The wealth of a State, and the number of its army, are the main elements for determining the total number of the fortresses which are to be built. This number being given, the most favourable of the points of all the kinds specified must be chosen.

Jomini states, it is best the frontier should be divided into parts, each part forming, so to speak, a separate frontier, and having a separate system of fortifications. Each system is to have three great fortresses on the frontier; three in the second line, which line may be considered approximately parallel to the former, at a distance of from 50 to 100 miles. Behind this second line there is to be one large fortress, also from 50 to 100 miles behind the second line.

It is clear that the number of parts into which a frontier is to be divided, to each of which is to correspond one of such systems of fortresses, depends on the total number of fortresses which can be allowed by the power of finding garrisons and money. Jomini allots as sufficient in his judgment, one such system of fortresses to every 190 miles of that portion of the frontier of France which is not maritime. He gives four systems to the Eastern frontier, and one to the Pyrenees.

When a portion of the frontier is defended by a line of extraordinary natural obstacles, for example, the Maritime Alps from Mount Blanc to the Col-de-Tende, the three large places in the first line, and one in the second, may be exchanged for little forts in masonry, constructed in the gorges, and small fortresses blocking up all the valleys by which, after passing the line of obstacles, it is necessary to debouch. When the frontier is not protected by great obstacles, the advantages of large fortresses over small, united to the impossibility of multiplying fortresses sufficiently to prevent the enemy from crossing the frontier without attacking a fortress, renders large fortresses preferable; but when the natural obstacles are such that, by replacing large fortresses by smaller ones, the enemy can be compelled to come under the fire of a fortress in order to cross the frontier, this is to be done.

Take the Maritime Alps (Map 1) and the passes by which it is possible to cross them, and the valleys by which it is necessary to debouch after having crossed them. Forts must be placed in the passes, and fortresses in the valleys.

PART 2.

On the effect of fortresses in retarding the strategical operations of the enemy, and the manner in which the enemy's fortresses are to be treated in strategical operations:—

1. Fortresses properly placed on decisive strategical points confer possession of the communications of a country. They

therefore render impossible many good combinations, probably all the most striking combinations, which the Principles indicate to the enemy, and which, if they did not exist, might be carried into execution.

2. Fortresses hinder and retard very considerably the march and progress of an enemy, by compelling him to take circuitous routes, sometimes to proceed without his artillery and baggage.

3. Fortresses weaken an enemy by compelling him to detachments.

4. A country entirely without fortresses may be conquered in a single campaign. As soon as the army is destroyed, it is entirely at the mercy of the enemy; unless, indeed, it be a country like Switzerland or Tyrol, full of extraordinary natural obstacles.

5. Fortresses protect the reorganization and recruitment of a defeated army.

Ex. to 1.—The part played by the fortress of Smolensk, situated on the great road to Moscow from Wilna, which traverses Russia from east to west at the point in which this road is intersected by the great road which runs north and south through the centre of Russia from St. Petersburg to Krew. This fortress, in addition to conferring possession of important communications, prevented Napoleon from forming a grand combination otherwise obvious in its excellence, and easy, from the position of the armies, in its execution, for cutting off the Russians from Moscow, and compelling them to accept battle.

Ex. to 2.—Duhesne, with 9000 men, was, in 1808, invested in Barcelona. It was necessary to succour him by carrying provisions to the place. This could only be done by the road from Perpignan, by Girone and Hostalric to Barcelona, Girone and Hostalric are both fortresses situated across this important road. St. Cyr received orders to raise the siege, and was not only compelled to make a circuit to avoid the fortresses, but from the nature of the country was compelled to leave his baggage and artillery behind, and attack the enemy without them.

Ex. to 3.—In seven weeks Prussia was in a single campaign overrun and conquered as far east as the Oder. The army being destroyed at the battle of Jena, and during the disastrous excentric retreat which followed, the whole country was entirely at the mercy of the French. It is true that Prussia had fortresses, and plenty of them ; but the fortresses were for the most part old, in bad repair, without a cannon in battery, and commanded by imbeciles, who gave them up as soon as summoned. Such was the foolish and absurd confidence of the Prussians that, while Napoleon was crowding bastion on bastion at Kehl and Mayence, scarcely a cannon was in battery at Magdebourg. One of the most important Prussian fortresses was mainly induced to surrender by the summons of Lannes, who was the only man in his corps d' armée within 70 miles of the place.

The guiding principles for the treatment of the enemy's fortresses are :—

1. No fortress is to be allowed to arrest for a moment the progress of more of the army than the corps necessary to observe or besiege it, according as the one or the other may be expedient. The rest of the army passes by it.

2. The corps necessary to observe or besiege being detached, the operations of the rest of the army are to be carried on with the same freedom and in the same manner as if the fortress and the corps of siege had no existance, except that the army retains more advantage than if the fortress and corps of siege did not exist ; for it can call to it a corps greater than the garrison sooner than the enemy can increase the garrison, since the besiegers or observers have the interior lines.

The best way for an army to protect the corps of siege of a place against an enemy sent to succour it, is to attack the succouring army, drive it behind some natural obstacle, such as a river, and place an army in observation before the obstacle. If there be no river or obstacle, one must be contented with driving the enemy as far as possible from the neighbourhood of the fortress. If the army protecting the siege is not alone equal to face the succouring army, the siege must be raised, and the besieging corps join the protecting army, and, together, beat the succouring army, and afterwards return to the siege.

Buonaparte's operations in 1796, when covering the siege of Mantua, offer a model of the wisest and best operations which an army protecting a siege can undertake.

GREAT MOVEABLE DETACHMENTS.

The following are the principal purposes for which great moveable detachments are employed:—

1. To oblige the enemy to retire, by menacing his line of operations.
2. To defend the line of operations.
3. To prevent or retard the junction of a detachment of the enemy.
4. To facilitate the junction of a detachment.
5. To observe and contain a considerable fraction of the enemy while a decisive blow is struck on another point.
6. To carry off a large convoy of provisions or ammunition, on whose safety the continuation of a siege or the success of a campaign depends.
7. To defend a convoy.
8. To make a demonstration, in order to draw the enemy in a direction in which it is wished he should march, in order that an operation may be facilitated.
9. To mask or invest one or more fortified places during a certain time, according as it is wished to contain the garrison within the ramparts or besiege the place.

Three examples to 8, and one to 3, have occurred in the sketches of the campaigns of Jena, Marengo, and Austerlitz; it is unnecessary to point them out. Examples to the other purposes are not given, because it appears useless to say that in a certain campaign a detachment was used for a certain purpose, without giving the circumstances antecedent and consequent to it; and, besides, this little treatise is not intended to obviate, but to facilitate and direct, the reading of campaigns.

The general Maxims 2, 5, and Napoleon's Maxim 2, relate to detachments.

Description of Sebastopol, from Official Report.

We are enabled to present our readers with one of the most substantial and detailed descriptions of Sebastopol which have been written since the commencement of the siege. It was drawn up by a French Staff Officer specially commissioned to do so by the Emperor. The task was ably accomplished at considerable personal risk.

"The town of SEBASTPOL is situated at the south side and at the entrance of a magnificent bay, offering in its *ensemble* a good anchorage for vessels of the largest class, which find eight to ten fathoms. This vast bay, or roadstead, the entrance to which is about a mile in breadth, divides itself into other smaller ones, but which follow each other; they are: Quarantine Bay, Artillery Bay, Arsenal Bay,—or, properly called, Military Port, in which are all the docks and military establishments—and Careening Bay.

"These different bays are situated to the south, on the same side as the town, greatly adding to the importance of its position; they contain the riches and resources of defence, and explain the bearing of our lines of attack, which now dominate and command them.

"Abrupt hills of a wild aspect surround the bay, at the extreme southern point of which is the mouth of the now celebrated river TCHERNAYA, which runs through the curious and picturesque valley of INKERMAN, illustrated by our arms.

Beyond, there is a vast ravine, one side of which is occupied by Russian troops, the other by the lines of the allies.

" Following the coast outside the roadstead of Sebastopol as far as Cape Chersonese, there are various other bays, one of which, KAMIESCH Bay, forms a natural port, unknown hitherto to foreign nations, and most valuable to us. The Russians have it not in their power to direct any serious attack against it. The entrance of the grand bay, or, properly speaking, the sea entrance of Sebastopol, is commanded on the north by FORT CONSTANTINE, with a double row of casemates, surmounted by a battery *en barbette*, situated at the foot of a cape, also called Cape Constantine, and having an average height of 100 metres. The fort deploys on a little peninsula advancing westward of the bay in a south-westerly direction. It is circular at its extremity, and bends in approaching the beach so as to form a sort of elongated semicircle. It joins the land by a horn-work which acts as a gorge. Behind the fort, and protected by it, there is a small bay with sufficient depth of water for steamers to anchor; they may be often seen there getting up their steam.

" Above Fort Constantine, and on the heights which dominate it, there is a fortified TELEGRAPH STATION, which appears to be armed with eight guns, and a great iron battery with fourteen guns, which can sweep the entrance of the bay. Since the commencement of hostilities immense works have been constructed by the Russians at the side of and behind this battery; but although they are far advanced it is difficult to say how many and with what sort of guns they are armed, as they have not yet been unmasked.

" Behind Fort Constantine, half way up the hill, on a small artificial plateau, there are various barracks and military establishments. Immediately below those establishments immense magazines and a quay extend along the beach to the interior of Constantine Bay.

" On the small promontory which terminates that bay there is the village and fort SIEVERNA, armed with upwards of eighty guns, and, like Fort Constantine, constructed of freestone. It has two rows of casemates and a battery *en Barbette*. From the sea it has the appearance of an oblong square; it is rounded off at the angles and flanked in the centre, facing the bay by a casemated tower not so high as the ramparts. Two polygonal towers are visible at the external extremities of the fort a few metres higher than the ramparts. The importance of these works may be seen from the land side, but it is impossible to see more.

"Between this fort and the other buildings a number of fishing smacks may be seen drawn up on the beach.

"There is another battery to the east of Sieverna fortified and closed at the gorge, but its number of guns is not known. From this spot to the extremity of SOUKHAYA point, the coast makes some curves, and establishments, which all appear to be military, are dotted on the eminences. Between the last of the points visible and Soukhaya there extends a ravine, into which a number of roads and footpaths lead towards the citadel, constructed on a plateau immediately above Soukhaya point. That citadel, or NORTHERN FORT, is a key-work in the conception of the *ensemble* of the system of defences of Sebastopol.

"The plateau upon which the Fort is built, and which forms a ridge, the incline of which extends from the opening of the port to the heights of Inkermann at the end of the bay, although green, and, to all appearance, covered with good earth, is totally bare of tree or shrub, probably not to interfere with the fire of the guns.

"This fort, according to Russian plans, appears formerly to have consisted of a simple *carré*, with bastion and curtains at pointed angles; cavaliers were erected behind each salient, and a great redan covered the road leading to the bay. Since the commencement of the siege the following works have been added:—The old fort has been completely covered and shielded by a *chemise*, with bastions of great elevation; a strong *lunette*, with other advanced works, extending over a great surface, and taking a line from east to west, have been constructed; and to the north, on the Belbeck side, great works have been thrown up, and continue down to the sea.

"Nothing more can be said about these new works, which are only visible at a great distance; this fort comprises, moreover, barracks and military establishments. The exact number of its guns is not known by us. Russian prisoners say that it is armed witn 400 guns of heavy calibre. This is evidently an exaggeration. However this may be, the 'North Fort' is of great importance, and it commands the roadstead and tho town north and south.

"The SOUKHAYA FORT, a battery, but which is more a fort than a battery, though the Russians call it by the latter denomination, consists of three works, connected with each other, viz., a very elevated work on the land side, with a deep fosse; an enormous bastion, and then a grand barbette battery in lozenge, constructed of freestone: the whole mounting at least fifty guns. At the back of the Fort there are vast military establishments, and a second gorge, where paths meet leading to the citadel. Backward, in the middle of the creek formed by the gorge, the steamers cast anchor, which perform the daily traffic of the place. From the extremity of the same gorge the hills become conical and rocky; the beach runs up the side of the bay, upon which military establishments are erected at intervals, at an elevation of never more than one third of the hills. At the end of the bay there is a lighthouse, which serves as a mark to vessels entering the mouth of the port. It is placed on the summit of the creek which extends inland. and forms the north side of the Tchernaya. From the mouth of that river to Careening Bay the hills recommence; but that part of the coast, although military establishments and houses are discernible, is unknown to us, and, consequently, it is impossible to describe it. On the other side of Careening Bay there is a battery or redoubt, which defends the approaches to it. Starting from the plateau which dominates the rear of that bay, a series of Russian fortifications commences, which we shall describe.

" ARSENAL BAY next comes under notice. It is the military port of Sebastopol, of which the great central bay forms the roadstead. The entrance is defended by an enormous fort of freestone, called FORT ST. NICHOLAS, with two rows of casemates surmounted by a barbette battery, and terminating in a "horse shoe," on the side of the entrance of the bay, and with a round tower at the entrance of the Arsenal.

" The east side of the bay is occupied by the docks, and numerous military establishments; and on its summits immense and magnificent barracks are built on the rock. The interior of the bay contains the parks of cannon-balls and stores of masts. It is on the west incline of this bay that the town of Sebastopol is built, in the form of an amphitheatre, on an isolated *mamelon* or point.

" It would be difficult to give a correct idea of Sebastopol from one point. Let us first take a look at it from the observatory in front of the French marine camp.

" From this point we can see the military port, or Arsenal Bay, in all its longitudinal developement; at its extremity FORT ST. PAUL, with its triple battery; at the side of that fort a quay, with ware-houses looking inland to the right; then rocks covered with small houses built of stone, all on the same model, and following the line of rocks. On the summit immense and magnificent barracks, at the foot of which the Russians have thrown up an earth battery, which mounts at least twenty to thirty guns.

" On the right, and in front of these barracks, making an angle with them, are vast buildings, now half demolished, once a first faubourg, before which the Russians have thrown up earthworks and an immense redan. Beyond that work, another portion of the faubourg is visible, defended by the MALAKOFF TOWER, and the fortifications belonging to it, and which close the plateau of Careening Bay. Let us now describe the west incline, upon which the town is situated.

"The whole of the hill, almost conical, which forms its perimeter, is visible. The ground, which is very uneven, is intersected by small ravines. A road starts from the bottom of the bay, leading in a zigzag to the top on to an esplanade on the summit. The construction of the houses, in the form of an amphitheatre is distinct. In the lower part there are large, long buildings, with tile roofs, forming a single ground floor; they have the appearance of barracks; neat, new, stone houses, divided by two unpaved streets, take an upward direction into the interior of the town. The largest is in the direction of the public gardens. At its extremity there is a palace belonging to Prince Menschikoff; and, a little lower down, a square building, which is the theatre. Above these houses and hotels there is a handsome church with white minarets, in the Russian style, with a zinc roof painted green.

"As regards the side of the town constructed with a regard to the works of defence, the houses are scattered over the inner incline, and the view is arrested by the line of fire of the Russian fortifications. Casting a look more to the left, the whole development of these fortifications is discernible; they form a vast wall, running up from the bottom of Arsenal Bay to the summit of the hill; a battery placed at the entrance of the esplanade already mentioned, and which sweeps the ravine, forms a continuation to Arsenal Bay. These different works join on to the FLAG-STAFF BASTION, which, in its turn, is connected with the TOWER BASTION.

"All these works have one or more rows of guns. In front of them extends another ravine, on the summit of which some of the batteries of the allies are placed. The last point visible from this spot is the extremity of the QUARANTINE BASTION, or Bastion No. 6. It is difficult to enumerate the armament of all the Russian positions; it may be said that there is not a single spot of ground left unoccupied where a gun can be placed.

"The second view of Sebastopol must be taken from the English batteries.

"We have now a side view of the city, and many of the works in the town are now explained. Arsenal Bay is no longer visible; the high ground caused by the ravine is alone discernible; the great barracks are now out of sight, but the ruined buildings in the rear are visible. Fort St. Paul is also concealed. We get a glimpse at the extreme right of the famous Artillery Battery, which mounts 192 guns, and we can count every arch of its casemates.

"The Battery terminates on the side of Arsenal Bay by a covered or round tower. Directly above it, half way up the plateau, there is a church with a dome. At another side the habitations already described, and the upper part of the church with the minarets, are seen. Here, especially, the aspect varies from the preceding view. The whole length of the ravine, which separates the faubourg from the town, lies before us. This ravine, on the first plan, that is to say, immediately above Arsenal Bay, is closed by the Kazarsky monument, built in the form of a temple, a group of handsome houses, and a small battery. The right side terminates with a patch of houses, fortified by means of earth-bastions, similar to those we are attacking. Some walls connected with them are embanked in the rear, and form real ramparts. The end is occupied by a barracks; an enormous battery of fifty guns connects this bastion with a portion of the *enceinte* on the right, which is not within sight. The left side is closed by a crenellated wall which disappears behind the Tower bastion in the front, which we are attacking; and on the incline of the ravine, in the left of the crenellated wall, is the faubourg, with the same development of fortifications as in the preceding view, only more foreshortened.

"After Arsenal Bay comes Artillery Bay, which is small, and surrounded by different buildings belonging to that branch of the service. Here is FORT ALEXANDER immediately opposite Fort Constantine. Like the latter it is built of freestone, with two rows of casemates, terminating in a massive tower on the side to the entrance of the roadstead. It mounts seventy-four guns, and is connected with QUARANTINE FORT.

"This latter fort, which comes next, is constructed entirely of earth, with a few stone facings; it has a triple row of batteries. Immense works have been added since the commencement of the siege, and it is connected with the town by a continuous line of different works; among others, two horse-shoe batteries. The Quarantine batteries sweep the ravine which protects the front we are attacking.

"On this side the town is defended by a crenellated wall, and by the Quarantine Bastion, which occupies the salient of the wall, and mounts forty-four cannon. One of its faces is defended in the rear by the flank of a demi-bastion, which has casemated guns; this crenellated wall after the bastion takes the direction of the TowerBastion, behind which it disappears. It is defended by a fossé and different earthworks thrown up since the commencement of the siege. After the Quarantine Fort comes the bay of the same name, one side of which is occupied by the fort, and the other by the Lazaretto, now in the hands of the French; by the Genoese Fort, and by the little church of St. Wladimir. At the bottom of the ravine we behold the cemetery and some country houses, now in ruins; then in front of the two elevated batteries, between Fort Quarantine and bastion No. 6, or Quarantine Bastion, a small village recently taken possession of by the French at the point of the bayonet. It is on the curve, a little in rear of the bay. The Genoese Fort is simply a ruin, in which the French at first established a battery.

"If we now place ourselves in the centre of the front of attack, and in advance of the French batteries, Nos. 1 and 2, we behold as follows, on the same line, stretching from the

Quarantine Fort on the extreme left, to the Flagstaff Bastion on the extreme right:—

"We behold before us an uncultivated, barren ravine, running parallel with the town, and some houses in ruins; the ridge of hills on the other side shoot down to the sea, and at its extremity is Fort Quarantine; then, going from left to right, we have the two horse-shoe batteries, and the works which connect Fort Quarantine with the town; then bastion No. 6, then the crenellated wall, with the salient, angles, and curves, which loses itself behind the tower, or central, bastion. In the middle of this bastion there is a heap of casemated constructions demolished by our balls, which have even swept away every vestige of the Tower. The central, bastion is, in its turn, flanked by other works. A ravine next comes in view, covered with some fortifications, and it terminates at Little Artillery Bay, the inclines towards which are studded with small houses, and on the right with houses of the town; we then come to the FLAGSTAFF BASTION, then, on the right of the Flagstaff Bastion, to the so-called ravine of the English; on the other side of the ravine we see the batteries of the great barracks, the GRAND REDAN and the MALAKOFF TOWER.

"After the Tower, or central, Bastion extends a ravine which forms the left incline on the hill upon which the town proper of Sebastopol is built. At its extremity we have the bay with the Artillery Arsenal, about which it is difficult to procure any details. At the entrance rises Fort St. Nicholas, which shuts in all the lower part of the town, on the side of the so-called 'port of Sebastopol.' Artillery Bay is out of sight. Some very formidable earthworks extend towards the right, as far as the Flagstaff Bastion.

"The FLAGSTAFF BATTERY is one of the most formidably armed of the place. It protects the faubourg in its rear, and is of angular shape. The dead angle of the Bastion is itself covered by a battery of four or six guns, with a ditch running continuously into the fossé of the bastion. It appears to have inside a 'cavalier,' furnished with Artillery, as two rows of guns are visible above. On the right of Flagstaff Battery there is a small curtain ending with a battery of eight guns. Then, starting from this point, the works take the direction of the town, following the line of the Arsenal ravine. All these works have gabions and palisades, and are protected by '*abattis*,' and ambuscades of sacks of earth, behind which the Russian riflemen are continually firing at the men in the trenches. At the bottom of Arsenal Bay, at the angle formed by the first curve of the ravine, a battery of French mortars has been very happily placed; and on the right of this battery, on the other side of the ravine, the extremity of the English lines is crowned by a battery of many guns. To oppose this battery the Russians have established on the incline to the right and left of the Arsenal Bay three Batteries. In front of the English battery, at about 1200 metres, are the magnificent Arsenal Barracks, at the foot of which the Russians have established the enormous Horse-shoe Battery already mentioned; then the Grand Redan and the Malakoff Tower described above."

The above very accurate description of the defences of Sebastopol is deserving of notice at the present moment, that the magnitude of the great success recently achieved may be better understood.

RETURN OF RUSSIAN FORCE PRESENT AT THE BATTLE OF THE ALMA, ACCORDING TO RUSSIAN OFFICIAL STATEMENTS.

Commander-in-Chief, Prince Menschikoff; Chief of Staff, Maj.-Gen. de. Brinn.

NOTE.—In Russian returns, names and not numbers of regiments are given. Generally also the titular Colonel's (Chef) name is given, especially when such "Chief" is a Royal personage.

Corps.	Divisions.	Brigades.	Infantry.	Battalions.	Boyonets.	Divisions.	Brigades.	Cavalry.	Squadrons.	Sabres.	Artillery.	Gunners, Drivers.	Guns.	Remarks.
5th. Maj.-Gen. Schabokrinsky, since promoted.	14th	1st	27th Line. Volhynia	4	2800	6th Light	2d	11th Hussars. Kiew	8	900	14th Brigade 12lb. No. 1		8	According to Russian official assertions, the average strength of battalions did not exceed 700 effective bayonets, or nearly 30 per cent. less than their normal amount on paper. *Russian Official Statement of Casualties.* Killed..........1762 Wounded.......2315 Contusioned.... 405 Ttoal..4482 Of these there were 45 officers killed, 101 wounded;* total, 146.
			28th do. Minsk	4	...			12th do. Ingermanland.			do. do. 6lb. No. 1		8	
		½	Reserves of the	2	1400				...	...	16th do. 12lb. Nos. 1 & 2		18	
			above two regiments	2	...			Regular Cossacks	12	1200	do. do. 6lb. Nos. 1 & 2		18	
6th. Lt.-Gen. Kwizinski, severely wounded, & since then invalided.	16th	1st	31st Line. Wladimir	4	2800			The 1st Brigade of the 6th Division, 11th and 12th Lancers, is not in the Crimea.			17th do. 12lb. No. 3		8	
			32nd do. Sudalski	...	...						do. do. 6lb. Nos. 3 & 4		16	
		2nd	31st Light. Uglitzski	...	...						Horsed do. No. 12		8	
			32nd do. Kasan	...	...						do. do. Cossack		8	
Lt.-Gen. Kirjafloff.	17th	1st	33rd Line. Moscow	...	...									
			34th do. Butirski	...	...									
		2nd	33rd Light. Borodino	...	...									
			The 34th. Tarutin	...	...									
			was not present	...	...									
			6th Rifles.	1	700									
			Marines	1	800									
			Sappers	1	800									
	3¼	5½		43	30,500				28	3000	11 Batteries.	2320	92	

RECAPITULATION.

Bayonets..............	30,500	Not including officers of Staff or regiments, amounting in round numbers to 1350.
Sabres.................	3,000	
Guuners, &c.......	2,320	
	35,820	
Add officers......	1,350	
Total combatants........	37,170	With 92 field-pieces, of which 32 were position-guns.

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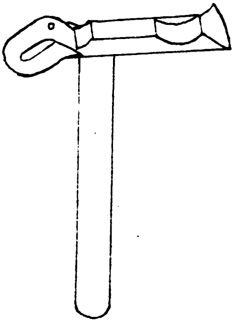
* Among the wounded officers were Lieutenant-General Kwizinski, since invalided; Major-General Schtschelkanoff, 1st Brigade, 16th Division; Major-General Goginoff (since dead), 2nd Brigade, 17th Division; Major-General Kurtyanoff (since dead), commanding 33rd Line.

Plate 15.



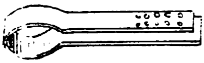
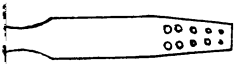


Fig. 10

Fig. 11.



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On the Ignition of Charges of Powder in Ordnance.

The various methods which have been employed, since the invention of fire-arms, to communicate fire to charges of gun powder have not generally kept pace with the improvements in the arms themselves. When the gun was a rude assemblage of iron staves hooped together and roughly welded—or when, as time and the arts advanced, it became a cylinder highly ornamented exteriorly with heads of griffins, serpents, and other noxious animals, with dolphins frequently executed with great artistic taste, but having the bore not unfrequently much out of the axis of the piece—or when it had become an unornamented truncated cone with an accurately bored cylinder, which it is at the present day—in all cases the method of firing the charge appears to have been that of applying some substance in a state of incandescence or ignition to the charge itself through the vent, or to loose powder placed in and about it. And the reason of so little improvement being made in this respect was probably owing to the fact, that the existing system answered the purpose so well as to render it almost a work of supererogation to seek a method which should answer better.

As far back as the year 1342, guns were fired by means of a thin rod of iron heated to a red heat, which was dropt into the vent; and this system obtained in some of the States of Europe as late as 1482. In fortresses there were fire-places made on the ramparts for heating these irons.

The next system used was that of pouring loose powder down the vent and about its mouth, and firing it either with the iron or the slow match which succeeded it. The first substance used for the latter, probably, was old and loosely twisted rope soaked in lye or solution of saltpetre; while on board-ship, where the cook's galley could at all times furnish a red-hot poker, the refinement of a slow match, which could be kept constantly burning, was unnecessary. Various were the receipts for making this match. It was requisite that it should burn slowly, that it should have a long and pointed *caput mortuum*, which, on blowing the ash away, might always present a clear pointed surface, thereby securing the instantaneous ignition of the priming powder. Paper soaked in various solutions was similarly made use of, and even certain porous woods. But, for convenience, the slow match long held the first place in the estimation of artillerists. The field guns, till very lately, had a yard or two of it attached to the carriage, which hung from the axle-tree; while the gunner with his linstock,* having a piece of the same match attached, fired the priming powder.

It had its disadvantages. The match was apt to go out, unless exposed to a current of air, and rain generally rendered it troublesome to keep alight. When a battery was suddenly called upon to open its fire, it might easily occur that the matches were found extinguished from either of these causes; or, through neglect, had never been lighted.

It was besides difficult to light the match on the linstock from that on the gun. This and other imperfections of the match gave rise to the invention of the portfire. This consisted of a paper case containing a composition driven into a solid by drifts of wood or steel tipped with copper. The composition was usually one of various proportions of the ingredients, sulphur, saltpetre, and mealed powder. They were so proportioned that the portfire should burn slowly, give a long and powerful flame, which could only be extinguished with difficulty. This was easily managed, and it was readily lighted from a slow match from which the ash had been previously blown off. The invention was certainly an improvement—the priming powder was ignited by it to a certainty—no rain could extinguish it; but it had the very great disadvantage of telling an enemy when the battery was about to open its fire, and, particularly at night, gave a most accurate mark for the sharp-shooter. At a siege, the light of the portfire at night was so sure to draw down a fire, that the old linstock was once more resumed for siege operations. The portfire, then was far from perfect. It was rather expensive and bulky, for a portfire of 15 inches long would only last a quarter of an hour; and much less, if the gunner who used it did not take care that the blast of the explosion coming up the vent did not waste it.

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* A word of German origin—“Lüntenstock:” “Lünten, matches;” “Stock” a staff or handle.

During the period in which these improvements had taken place in guns, the musket had gone through others, having reference to firing the charge, and more successfully. The match was more inconvenient for the musket than it was for the gun; for, in addition to the disadvantages above attributed to it, it was not unattended with danger to the man who carried it in loading with loose powder, frequently causing explosions or setting fire to his clothes; besides requiring one hand for its use, while the other with difficulty supported the clumsy weapon with the butt in the middle of the chest!

The first improvement applied to fire-arms, dating 1378, was that of a simple lock called a "Serpentine," from the cock, which was fashioned into the shape of the head of a serpent. It is still used in the East, and consisted of a split cock to hold the match, while a trigger, acted against by a spring, moved the cock slowly downwards and without a jerk, until the match touched the priming powder in the pan. This was no contemptible arrangement, and capable of giving much better practice than our present percussion lock with its pull of four or five pounds on the trigger.

Next came the wheel lock. There is reason to believe it was invented in Germany about the middle of the fifteenth century, and was in use with troops about the beginning of the following century. It was successively improved at Nuremburg in 1517, 1573 and 1632, and at Venice in 1587. It was difficult to make, was therefore costly, and was generally put into the hands of the Cavalry. It was composed of a steel disk, seratted at the edges, which revolved with rapidity by the action of a spring which was cocked or wound by a key, like that of a clock. This disk rubbed against a piece of iron pyrites or later on a flint, creating a stream of sparks at the point of contact of the disk and the priming powder.* This had certain advantages over the matchlock as well as certain disadvantages. Rain or damp had little or no effect upon it, it showed no light to the enemy, nor did it endanger or burn the clothes of the Soldier; but it was difficult to make good practice with a piece so equipped, because it required strong nerves to hold it steady while this fizzing mechanism revolved, sooner or later firing the priming, but at no certain instant. It was, however, a grand step, and proves that the mechanical arts were making great progress.

About the year 1630, the flint lock made its appearance, and was, after a considerable hesitation, adopted by all the European powers towards the end of the century. It has been improved from time to time, and is almost identical in its mechanism with the percussion-lock of the present day. It was adapted to the guns of the navy with great success many years afterwards, with slight modifications and improvements, such as a double headed cock carrying two flints, whereby the probable necessity of changing a flint during an action was avoided.

We must now return to the gun, to bring it down to the same period viz., to within the last fifteen years.

Loose powder priming was succeeded by the tube, in consequence of the liability of the former to get blown away, wet, &c. The date of its invention is not accurately known, but it seems to have been used as far back, at least, as 1683. Tubes were formed of various materials, but in construction and principle were all nearly similar. A tube or pipe filled with powder, with a hole through it, ending in a cup primed with a paste of powder, conveyed the fire to the charge. The tube was made of various materials; of metal—tin, brass, copper, and perhaps zinc—of quill, of paper, and of reed, the cup was variously formed; with metal tubes it was composed of like metal and soldered on, and with paper tubes it was of paper pasted on. With quill tubes, it was formed by interlacing worsted threads, like the withes in basket work, in and out of the small pieces into which the top of the quill had been purposely split. The tube itself was either charged with mealed or finely corned powder, and invariably had a small hole pierced through it; the object of which was that the powder in the tube might be inflamed in its whole length at once, otherwise it would burn like a fuze, and only ignite the charge as soon as it had burned through. The cup, in all cases, was primed with a paste composed of mealed powder and spirit, and in some cases bits of quick match were added.

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* Piobert.

The flint lock and portfire have, up to the last fifteen years, then, fired the villainous saltpetre; but during those few years great improvements in arms have been made. Science has been more directly applied to them than formerly; and it was natural that the method of igniting the charges contained in them should benefit by this enlightenment.

The detonating or percussion system had been in use among sportsmen long before it was adapted to weapons of war. The first percussion caps used were charged with a powder of which chlorate of potassa was the ingredient which detonated. This was found to corrode the metal of the nipple. Fulminating nitrate of silver was tried, but abandoned in consequence of being too easily explosive, the contact of a cold substance being sufficient to explode it. Howard's fulminate or nitrate of mercury is now generally employed for percussion caps, is found to leave very little residuum, and to be nearly " anticorrosive," as the caps have been sometimes termed. It is in some services mixed with saltpetre, as with the French, in others with pounded glass and antimony.

In the year 1840, nearly all the powers of Europe altered their arms to the percussion system, and the copper cap or tube most advantageously replaced the priming powder. The success of this system with muskets and rifles, naturally turned the attention towards applying it to Artillery. There were certain differences of condition, however, under which the charges in the one case and the other were to be fired, such as to render it less easily applicable to guns. In the former the flash of the detonating powder had but a short distance to pass through before it came in contact with the gun powder of the charge, which laid loose in the bottom of the barrel; whereas, in the gun, it had to go through a distance of several inches, according to the size of the piece, and then it found the powder tightly enveloped in serge; and though the priming wire left a hole in the bag, yet the elasticity of the material of the bag immediately caused it nearly to close up on withdrawing the wire. So that the system of having a large nipple as a vent to the gun, which was fitted with a large sized percussion cap, as might have been expected, did not fire the charge with the necessary certainty. Several modifications of this plan, into which it is unnecessary to enter, were tried, but all with indifferent success.

The common tube, it was known, would fire a charge of powder, contained in a serge bag unpricked, at a distance not of a few inches only, but of four or five feet. If, then, the percussion principle could be joined to the tube, a means of firing a charge would be obtained which apparently would make a close approach to perfection. This idea once entertained, it was not difficult to carry it out. This was effected in various ways.

France made a tube thus:—a common quill was split at the top, and the split pieces were beaten out at right angles; upon these were pasted a couple of rings of stout paper, and on this a percussion paste, composed of one part fulminate of mercury, one part of mealed powder, with a sufficiency of gum water, was spread, a small portion being inserted into the tube itself. In all other respects the tube was of the usual construction.

England had almost the same thing—a quill tube having a short arm, at right angles to the length of the tube, formed of the end of a pigeon's quill about ¾ inch long; this carried a charge of percussion powder or paste composed of

	Grains.
Chlorate of potassa..............	230
Antimony	230
Glass finely pounded............	73

in other respects, the tube was identical with the common quill tube.

Wurtemburg adopted one somewhat similar—a tube made of reed, capped with copper, having a thin copper tube inserted in a hole at right angles to the length of the greater tube. The copper tube projected equally on either side, and was struck by the hammer of a lanyard-lock, so shaped as to strike it on both sides. The percussion powder used was muriatic.*

Holland made and used a wooden tube having a percussion copper cap. The percussion system is, or was, in use with the Field Artillery, and although the vents of its guns are much larger, probably than those of any other powers of Europe, it was found necessary to adopt a species of moveable vent, which forms part of the lock.

Bavaria has, or had, a reed tube of the usual nature, but having an obtuse-angled capsule inserted and tied to the tube; the exterior half of which is filled with fulminating powder, the interior half with mealed powder. A blow from the hammer of a lanyard-lock fires the tube.

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* The chief ingredient, was therefore, doubtless chlorate of potassa.

In Sweden the system invented by Kallerstræm found favour. In construction it differs from any of the above, and it is therefore given more in detail. (*Vide* fig. 1, Plate 15, a section). The tube is of copper, having a ring of thin iron wire soldered to it above. Half an inch below this two iron wires are twisted tightly on to the tube, the twisted ends extending out on both sides, thus preventing the tube from falling into the vent and leaving half an inch of it above the vent. The cylinder of the tube is filled with mealed powder within half an inch of the top; into this empty portion a capillary tube ¾ inch in length is inserted. It is of glass, and is filled with sulphuric acid, and hermetically sealed at both ends. It is covered exteriorly with a composition of 66 parts of hydrochloric acid, 10 parts of charcoal, 12 parts of flowers of sulphur, 6 of refined sugar, and 6 of cinnabar. The bottom of the cylinder is closed with sealing wax. When, then, the tube is placed in the vent, if the upper portion of it be bent to one side by any means, the capillary tube is broken, and the sulphuric acid, coming in contact with the materials of the composition around it, causes inflammation. The tubes are carried in a small box, with a horizontal shell in it, pierced with holes in each of which a tube stands upright. This box is placed between the cheeks of the trail of the gun carriage, which, in the Swedish construction, are very close together, and, consequently, the tubes are not liable to accidents or accidental explosion.*

This tube is a percussion tube, but requires no lock to be affixed to the gun, as it may be fired with a stick or a hook, and is therefore, and for other reasons qerhaps, an advance upon the others above detailed. The Emperor Louis Napoleon, in his Manual of Artillery, published in 1836, states that it has been abandoned in consequence of several serious accidents of which it was the cause; but as it appears in the work quoted in the foot note, from which the above information has been extracted, and which was published in 1849, the probability is that His Imperial Majesty was misinformed.

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* The data regarding the Swedish tube are extracted from the "Etat Actuel de l'Artillerie de Campagne Suédoise, par Jacobie. Traduit par Sengleir."—Paris, 1849.

The percussion tubes answered well, but there was one objection to them (which does not apply, however, to the Swedish tube, but which must be put out of the question from its obviously dangerous nature), viz.:—that they required a percussion lock to be affixed to the gun. For naval, or perhaps garrison Artillery, this was of no importance; but for field or even siege Artillery, it was a different matter. Field guns are liable to be upset, not only on a plain, but down precipices, and to receive all sorts of rough treatment: any excrescence, therefore, is to be avoided, more particularly one upon which the efficiency of the gun is mainly dependent; and consequently percussion locks, like flint locks, were found to be generally inapplicable to field Artillery.*

The next and latest invention, that of friction-tubes, was doubtless taken from that of the old lucifer-matches, which were in use some years back, and which were inflamed by rubbing a composition at the end of the match between the folds of a piece of doubled sand paper. The first tube of this nature was that of Captain Burnier, who published the details of his invention in the *Journal des Armes Spéciales* upwards of twenty years ago.

The tube was of paper stiffened with tape; the upper part of it was split downwards for about an inch, and the interior of the halves of the cylinder filled with a paste composed of chlorate of potassa, sulphur, and antimony, in equal parts.

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* There are several exceptions, as will be seen in the text above, but locks were not adopted by any of the great European powers in the field Artillery.

While this composition was still wet, a hollow was made in it to admit of the end of a string covered with emery glued to it. When the paste was perfectly dry, the emery end of the string was introduced into its place, and the top served tightly round with twine to ensure contact and friction when the rubber was pulled out. To prevent the tube being pulled out of the gun when the rubber was hauled on, a loop of string was tied to the centre of the tube, and the loop end hooked over a button close by the vent. This tube, improved upon, is the one now in use in the French service, which is thus described in Thiroux' *Instruction d'Artillerie.*

" It consists of a copper tube AB (fig. 2, Plate 15) split into a cross at top A, to prevent it falling into the vent. Immediately under the head it has a choke, thus reducing the internal diameter at that point. The explosive apparatus consists of a little copper tube C which is placed in the greater tube, and contains a fulminating composition of antimony and chlorate of potassa. While this composition is still wet, a brass wire, flattened out and roughened at the end, is sealed into it. The lesser tube is introduced into the greater by means of the wire, so that the former should just touch the choked part, the remainder of the wire is then twisted into a loop, whereby it is caught by the lanyard-hook. The empty part of the tube is filled with musketry powder, and the orifices, above and below, are filled with melted beeswax. The charge in the piece must be pricked with the priming wire before the tube is entered into the vent. This tube is inapplicable to the mountain howitzers, as the force required to explode it is likely to derange the laying of the piece."

The British friction-tube is somewhat similar, but has the advantage, like the Prussian one hereinafter described, of having the rubber at right angles to the tube, whereby the possibility of pulling the tube out of the vent when about to fire is avoided. It is mostly made by machinery ingeniously and economically devised; but as it must be considered imperfect—an assertion which, it is hoped, this paper will warrant—its manufacture and that of a better existing system will be more fully detailed.

1. Forming the Tube.

a. *Drawing.*—The sheet copper, similar to that used for percussion caps, is cut into strips of a sufficient width to form a tube of the prescribed diameter (0. ″1) to fit the vent. The end of a strip is wrapped round a mandril with a wooden mallet, so as to give that portion of it roughly the form of a tube, and to enable it to enter the eye of the drawing-machine. This is precisely on the same system as a wire-drawing machine; the strip is entered at one side of the eye and comes out at the other a tolerably close-jointed tube, though neither air nor fire tight.

b. *Cutting to length.*—This is effected by a circular saw working in a lathe. There is a stop, consisting of a flat piece of copper, against which the end of the uncut tube rests, thus ensuring that the saw cuts off an equal portion each time.

2. The Nib-pieces are stamped out by a punch into the shape shown in (fig. 3, Plate 15) at one blow. The machine carrying the punch is similar to that for punching the crosses for percussion-caps, as is the other punching machine used in the manufacture of the tubes. They are then hammered round a mandril into the shape shown in fig. 4, (Plate 15). The tongues of the nib-pieces are left (unnecessarily) too long; a small portion has, therefore, to be nipped off with a pair of pliers.

3. The Bar is punched out and roughened, as shown in the margin in fig. 5, (Plate 15), at one blow; the point is bent over ($\frac{1}{16}$ inch) on to itself with the pliers, and the ring has a slight bend given to it.

4. *Fitting.*—The nib-piece, having been hammered
a. round the mandril, is fitted on at right angles to the length of the tube, the two tongues are pinched together, and the

b. superfluous length nipped off. It is then tied on to the
tube by a very fine copper wire, two rounds being taken
above the nib-piece, two below it round the tube, and two
c. round the nib-piece itself. It is then soldered by melting
a small quantity of solder on the end of the soldering iron
d. and dipping the tube into the melted metal. A hole is
next bored through the side of the tube, to make a commu-
nication between it and the nib, by an awl revolving in the
e. mandril of a lathe. It is then filled with mealed powder,
dry; the empty tube is dipped in a cup of the powder, a
thin drift inserted, and the tube being reversed, the drift is
tapped against the bench, and it is thus gradually filled. A
hole is then pierced through from end to end with a fine
f. pricker. The tube is next taken to have the friction pow-
der and the bar inserted. The latter is pushed in as far as
it will go, and two small pieces of the powder in cake are
inserted, one above and one below, about the size of fig. 6,
(Plate 15.) This powder is composed of precisely the same
materials as that used in percussions tubes mentioned in page
399. The end of the nib is then pinched down with the
pliers until it has secured the bar and pieces of cake friction
powder. The ends of the tube are closed by a couple of
g. disks of paper pasted on. The whole tube is next covered
with a lacquer composed of copal-varnish, lamp-black, and
turpentine. They are hung up to dry on racks formed of
the straps of copper from which the crosses for percussion
caps have been cut. This is a very minute detail, but they
form more convenient and economical racks for the purpose
than probably could be purposely devised.

The tube, when finished, presents the appearance of fig. 7, (Plate 15.) A hook at the end of a lanyard being inserted into the eye of the bar, the bar is pulled out of the nib, thus rubbing its corrugated surface against tha friction powder, causing the ignition of the powder in the tube.

This tube has but one fault, viz.:—the possibility of pulling the bar out without firing the friction powder, an occurrence which this writer has witnessed, though of course rarely. Now if there can be devised a method by which this cannot possibly occur, it must surely be an improvement. This is effected in the Prussian friction tubes *(Friction-Schlagröhren)*, which are described below with every detail. This fault arises from the method of putting in the bar and friction powder, the latter being in a dry state, and, consequently, requiring delicate handling; while the securing them in their position by the pliers is at best a clumsy operation, and, it has been shown, not always an effective one.

If the Prussian tube is superior to the British one, as it is presumed will be made evident, our practical readers will be glad to have the detail of its manufacture *in extenso*. It is translated from the " Lehrbuch der Artillerie für Preussischeavancirte dieser Waffe," 4th edition. Berlin, 1853. The figures are from " Die Waffenlehre," Berlin 1853.

FRICTION-TUBES, (Frictions-Schlagröhren.)

§ 278. Friction-tubes are to be distinguished from tin or common tubes chiefly from having, instead of the cap at top, a long capsule (nib), in which a friction-charge and a doubled strip of brass with an ear (the bar) are introduced, and which are retained in their positions by pinching to the sides of the nib. If the bar (or rubber) be now pulled out by means of its ear, the friction charge is kindled and communicates its fire to the charge of powder in the tube.

(a) *Nature of the tubes.*

The tubes, nibs, and bars are made of the same metal, sheet-brass. The tube (fig. 8, Plate 15) 0."24 in diameter and from 1."56 to 1."7 long, has a burr on the top, whereby the better to fasten the nib to it. The latter (figs. 9 and 10, Plate 15) has interiorly and on the lower side a flat surface 0."26 broad by 0."77, which is partially roughened by means of a punch. The hole, in which the tube is to be soldered, punched from the inside to the outside, thereby leaving a burr, is close to the hinder end of the nib.

The bar or rubber is a strip of sheet-brass 0.″21 wide, narrowed slightly towards the middle, where it is bent in two, thereby forming an ear or loop. To be correctly doubled, the lower half, roughened 0.″36 from the end and slightly obliqued, is shorter by 0.″05 than the upper and smooth portion. The roughening is effcted by punching holes from within to the outer side ; the upper and smooth portion has, immediately at the ear, a point struck out on it as a mark.

(b) *Examination of the Tubes and Bars.*

(Generally a revision-punch is used for this purpose the nature of which is explained in the instruction.)

§ 279. It must be ascertained—

1. Whether the tubes go through the gage (a hole in the revision punch), and are properly soldered in their whole length.

2. Whether the punch (a thin cylindrical arm of the revision-punch) goes easily through the curved cheek of the nib and conveniently through the tube.

3. Whether the nib is so tightly fastened to the tube that it cannot be torn off without great difficulty, the burr of the tube sufficiently wide and properly beaten down, and that the nib is tight down on the tube.

4. Whether the inner and longer side of the nib is roughened, the upper bent surface smooth, that it may not be broken in the pinching to.

5. Whether the bar goes easily into the nib, its ear or loop not too small (measured by means of the thick cylindrical arm of the revision-punch), and the point or mark thereon be correctly placed. Besides, the revision-punch has a prismatic part for the examination of the interior of the nib.

(c) *Driving.*

§ 280. The driving is carried on like that with common tubes,* with however, more powerful blows; likewise the last layer of powder is roughened by the pressure of a punch made star-shaped at the bottom, that the friction-charge may the better stick to it. In examining the driven tubes it is requisite to see—

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* The tubes are driven full of corned powder over an iron spindle, which is fastened into a leaden foot by means of an iron drift. The object of the hole thus left in the tube is the quick communication of the fire. The leaden foot and the corned powder, which is contained in a shot bottom, stand, during the process of driving, upon a block 2 feet high. The empty tube, cup upwards, must be firmly placed over the spindle, which has a shoulder at its lower end. In the first instance, a very little corned powder must be put into the tube with the

1. That the tubes are driven quite full, and that the upper portion is roughened.

2. That by pushing with a wooden plug no portion of the powder column comes out.

(d) *Application of the Ignition Composition.*

§ 281. The ignition composition is composed of 2·6 oz. of pulverized chlorate of potassa, 2·6 oz. of pulverized antimony, and a 0·9 oz. powder measure full of solution of isinglass. The chlorate of pottassa placed in a dish has the solution of isinglass poured over it, and is stirred with a wooden spatula until the whole is moistened. Thereupon the antimony is added and a 2 oz. powder measure of good spirits of wine poured on to it, and the mass rubbed until (some 5 to 10 minutes) it is intimately mixed and has attained the consistency of honey.

(e) *Preparation of the Friction Apparatus.*

§ 282. Smearing.—Two workmen have near each of them a little box of the driven tubes upon a table. They first thinly smear an indefinite number of bars on the roughened side with the ignition composition, and hang them up to dry upon pins on the sides of a box placed in front of them. They then commence on the tubes. The whole under side of the nib as well as the top of the powder column is smeared with a layer of ignition composition, but not too thickly; the hole through the powder column of the tube is cleared at the top, while the wet layer of ignition composition is pierced through with the point of a tube-spindle; then a bar, upon which the composition must be quite dry, is laid, smeared side downwards, upon the still wet ignition composition of the nib, and the tube placed in a board provided with holes for the

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ladle; the drift placed thereon, and this layer beaten by six equal and gentle blows of the mallet. Then a whole ladle-ful is put into the tube and the leaden foot struck a blow with the mallet, thereby causing the powder to settle; the drift inserted over the spindle and struck anew with six blows. In this manner the process will be continued until the tube is driven quite full, which must be then carefully withdrawn from the spindle. Faultily driven tubes must be bored through with the auger; stopped up drifts will be cleared with a pointed borer, but not in the laboratory.

purpose. These two workmen have after that to take care that none of the ignition composition protrudes from the nib or drops on the table. Should it, however, so occur, it must be removed in the first case with a bit of serge, in the second with a wet cloth, because it would otherwise dry and might very easily inflame.

The ignition composition, which the two workmen use, is placed between them in a dish, and must be continually stirred by a third workman, in order that the antimony may not settle at the bottom. He has, besides, to bring from below the surface the thickening composition, by means of wiping the brush on the sides of the dish; and, further, to see that it does not become too thin, but always retains a pappy consistency. The empty dish is to be washed clean under water.

Pinching to.—A fourth workman takes the tube from the above mentioned board to the pinching machine, which must always be kept clean and greased; he satisfies himself as to whether the point on the bar-ear is upwards, places it in the machine, lets the screw run down, and presses on the lever equally with both hands, but not too strongly. Thereupon he lets the screw play upwards, without permitting it to strike above, takes out the tube, and puts it into a shot bottom. If the upper plate of the nib should be broken, he satisfies himself that it does not remain fixed in the die, because otherwise the regular pressure would be hindered.

Further manipulation.—A fifth workman receives the pinched tubes, cleans them from any composition which may have exuded, with a cloth wetted with spirits of wine, and places them on a board to dry. As soon as a board is filled it is removed. The so far prepared tubes must be once more examined as to whether the point on the bar is uppermost, and must, before further handling, be properly dried, which takes place in warm weather out of doors, otherwise in a heated room, and they require here alone 24 hours at the least.

(f) *Kitting.*

§ 283. All the joints of the perfectly dried friction apparatus, and likewise the empty space of the bar-ear, when the two plates of the bar lie together, must be well smeared with kitt* and the tubes again dried.

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* 5·2 oz. of gum arabic must be dissolved in 24 quarts of water, then as much pulverized chalk added as to form itself into a viscous pap. Of this kitt only as much as is requisite for the nonce must be prepared.

(g) *Closing and Lacquering.*

§ 284. In order to close the tubes at bottom, suitable little disks of paper (not too thick) must be cut with a wad-cutter. One disk, by no means more, that the closing be not too fast, is taken and pressed tight against the powder in the hollow at the bottom of the tube, by means of a little plug of wood. The lacquer* with which the nib and the lower opening of the tube is to be endued, must not, especially for the latter, be too viscous, but be kept as liquid as possible. The Friction apparatus must be lacquered on all sides, particularly about the ear and the inner part of the same, when it enters the nib, to preserve it from humidity.

(h) *Packing.*

§ 285. The packing is the same as with common tubes,† only that with these there are 22 tubes in each packet, so that one always receives equal to $\frac{1}{10}$ the space.

(i) *Rules regarding Measures of Safety.*

1. In the locality where the smearing and pinching to takes place, no other powder work should be carried on, or other powder munition or compositisn exist.

2. More tubes than are necessary, with a view to prevent interruption of the work, should not be permitted to be at hand.

3. The completed tubes must always be at once removed from every place where work is going on.

4. The smearer must always place the smeared tubes upon the board and not lay them down on the table; he must be continually guided by the pincher to, whereby the work in its progress continues without accumulating a great stock, which might easily be disadvantageous, especially in warm weather, if in consequence thereof the ignition-composition should become dry, whereby a conflagration might ensue through the accidental pushing of the bar.

5. The smearer must further leave the unsmeared tubes invariably in the box, and not place a few of them on the table, because they might become mixed with the smeared ones.

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* 1·3 lb. of asphalte (Jews-pitch) and 0·32 lb of amber-resin, reduced to small pieces, must be dissolved in a bottle with 0·95 quart of the oil of turpentine. Before using it, it must be shaken, and when it gets thick through keeping, it must be liquified with a little oil of turpentine.

† The tubes are packed for use by 20 in half a sheet of paper, laid in 4 layers, so that in the first and third layer there shall be 6, and in the second and fourth 4 tubes, by which means the heads and tails are alternated in each layer. The paper, when wrapped up, is fastened by a cross tie of medium twine.

Firing.

§ 556.—No 3, Fires.—The hook of the firing-lanyard is hooked into the ear of the bar, and then the tube is set home into the vent up to the bar. The lanyard should be first pulled tight, and at the second motion the bar is torn out by a short strong jerk of the right-hand. In doing so the right hand should not strike against the body but should pass by it. Friction-tubes that have missed fire can be fired by means of the portfire, for which purpose the tube is so bent at the opposite end to the ear that the column of composition immediately under it is exposed, where the flame of the portfire acts more surely on the tube which has been again placed in the vent. Should the friction apparatus break off, the upper end of the tube is wrapped round with yarn so thickly, that it cannot fall through the vent, and is then fired. Should the apparatus of a friction-tube break clean off and the tube fall into the vent, so that it cannot be taken out by the hand, it must be driven carefully downwards with the vent-drift (the introduction of which as a portion of the equipment of a field-gun for that purpose may be expected), and another tube introduced.

The trigger-line with its hook, handle, and loop, is, inclusive of the length of the hook and the thickness of the handle, 29″ long. The hook is filed out of a piece of iron (not made of wire) and tinned.

The advantage of this tube is obvious. The rubber and friction powder are all fastened together in such a manner as to form a solid body, The head is stamped in the machine with considerable force, ensuring perfect contact between nib, rubber, and powder; and if the powder be good, in consequence of the roughened rubber, which is punched like a nutmeg grater, it is physically impossible to pull the rubber out without firing the tube.

We have thus, it is hoped, put our readers in possession of almost every thing which would be useful to know on the subject of igniting charges of powder in ordnance. If we have been lengthy and entered somewhat more into detail than perhaps some of them would desire, we have at all events got together into a few pages all the information we have been enabled to obtain on the subject, and these pages may be thus more useful for reference to Officers of the Arm, to whom that subject should be more particularly of interest.*

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* Uuited Service Magazine for January 1856.

in Shells.

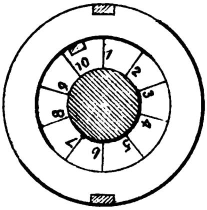

Fig. 5.

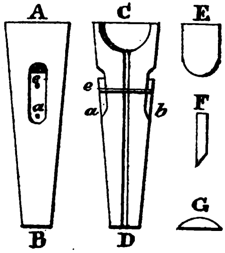

Fig. 9.

H.J.K. Lithogr.

On the Ignition of charges of Powder in Shells.

It may be said that the man who first discharged a shell, laden with powder and having a burning match attached to it for its explosion, was not surpassed in courage by him whom Horace describes as first tempting the waves; they both made the experiments at the imminent risk of their lives. Vulturius attributes the invention to Sigismund Pandolph, a gentleman of Rimini, who died in 1457. There appears to be considerable doubt, however, as to the century even in which the shell was invented. At the siege of St. Boniface, in Corsica, in 1421, it is supposed that shells were used, but there is a doubt whether the projectiles thrown on that occasion were of the nature we should term shells. Some ancient writers assert that a Danish Prince was killed by a shell in 1361, and that they were used at the siege of Ratisbon in 1388; but their evidence on this point has been thought to be of a doubtful nature.

The first shells were made of wood, stone, or copper, and, about the year 1460, of bronze. They were made in two hemispheres, joined together by a hinge, and kept firm in that position by a strap of metal.—It was in this form they were used in Italy in the middle of the fifteenth century. We are told, further, that in the war against Naples, in 1495, they were employed in considerable numbers; as likewise at the sieges of Padua in 1509; of Heilsburg in 1520; of Mezieres in 1521; of Rhodes in 1522; and of Boulogne in 1542. It was about the last date that shells were cast of various fragile metals,*

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* The above historical details are extracted from Piobert's work on Artillery; he gives as his authorities.

"Vulturius, De Rei Militari. Veronoæ, 1472 e 1483."
"Gentilini, Instruttione di Artiglieri, in Venetia 1598," and
"Biringuccio, Pirotechnia. Venetia, 1540 et 1550."

Fuzes* must naturally have been contemporary with shells, and there exists the same doubt as to their inventor and the date of the invention. A simple plug of wood with a hole in it, filled with a slowly burning composition, appears to be an obvious method of firing a charge of powder inside a shell; but it was not the first method employed. And here it may be remarked how often men raise up imaginary obstacles in the path of invention, and exercise all their ingenuity to overcome these visionary stumbling-blocks. Railways may be instanced. It was thought that the wheels of a Locomotive Engine, placed on a smooth rail, would not bite sufficiently to enable it to progress; but that the driving wheel, when set in motion, would revolve without advancing. Cog-driving wheels with cog rails were proposed in consequence; but it was evident that the friction and consequent wear and tear would be so great that anything like a rapid velocity was not to be hoped for. This misconception kept back railways for twenty years.† So of shells. It was thought necessary to provide means for igniting the fuze other than that of the inflamed gas produced by the explosion of the charge in the piece. Double-firing—or firing the fuze first and the piece afterwards—was for many years the method by which the charge in the shell was eventually ignited; and for this purpose at first a match was used and afterwards a sheet iron tube, brazed to the shell, containing a match or composition, and communicating with the charge by two side holes. This operation, which could only be affected in short pieces, such as mortars, bombards, and howitzers, was found to be a dangerous one; as from the charge being loose in the bottom of the bore, into which it was introduced by a ladle, the communication of the fire from the fuze to the charge behind the shell was by no means an improbable result, and that too before the bombardier had got out of the way. The system of loading with the shell placed in the piece, with the fuze next the charge, was now adopted; but it required special arrangements to be made, that the fuze or the fuze composition should not be driven into the shell by the explosion of the charge, and thus cause a premature explosion. Two systems are on record. The one consisted of a metal fuze, which passed through the shell and was rivetted at both ends, having small holes in the centre to permit the escape of the flame into the charge as soon as the combustion of the fuze composition had reached them. The shell, like our more modern ones, had an additional hole at one side through which the bursting charge was introduced. The other had but one fuze hole, and opposite to it interiorly there was a female screw cut in the metal of the shell, into which a metal fuze, having a male screw tapped at its lower end, was fastened. The flame escaped through four holes at the side and bottom of the fuze. It seems that these fuzes did not give satisfactory results, for the system of loading fuze outwards was resumed.

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* The word fuze, or fuse, is said to be derived from the French and English word *fuser*, to fuse.

† *Vide* pages 372 and 373, Lardner on the Steam Engine, 1851.

A wooden fuze, shaped like a truncated cone or a combination of such a solid and a cylinder, pierced with a hole charged with various compositions, was next adopted, and with its contemporaries, the flint lock and portfire, for many years did yeoman's service, and continues to do so either in its simple or slightly modified form.

Having thus given a general notion of the fuze and its history, we will proceed to define it and to lay before our readers the different natures of this item of pyrotechny which have been invented within our own times.

A fuze, in its most general sense, may be defined as a tube of various shape and material, containing a column of inflammable composition, which is placed in a shell to communicate fire to the charge of powder therein contained at any determined moment. To be a perfect fuze, however, it should be capable of being timed when fastened into the shell* in a simple manner, such as may be done with certainty under fire and in all the excitement of an action, of withstanding all vicissitudes of climate and transport, of being used at night, and it should be inexpensive. This is a problem upon which artillerists have expended a great deal of thought and ingenuity, but up to the present moment it remains unresolved. We hear a great deal of the mechanical ingenuity of Englishmen now-a-days, especially of that of Civil Engineers. Let us recommend the subject to their notice, but we do so with no great hopes of their success; and yet pyrotechny, especially as regards fuzes, has made considerable advances lately, and who shall say that an Œdipus shall not yet appear to expound this enigma?

All known fuzes may be thus classified :—

1. Fuzes timed and fixed beforehand.
2. Fuzes timed and fixed in action.
3. Fuzes timed beforehand and fixed in action.
4. Fuzes timed in action and fixed beforehand.
5. Percussion or concussion fuzes.

1. *Fuzes timed and fixed beforehand.*—This is evidently the simplest and least perfect system of fuze, because the power of altering the moment of explosion is sacrified. It is peculiarly applicable to sieges when the Batteries fire for a long time at the same immoveable objects situated at known distances. It is applicable to naval and coast artillery shells, when the object is to penetrate the side of an enemy's vessel, provided the composition be only long enough to last while the shell is passing through the air and lodging in the ships side ; for this purpose it answers perfectly, for it is a matter of no importance whether the shell explode immediately on lodging or ten or fifteen seconds afterwards. With the continental powers it is used for howitzer shells. These pro-

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* We have stipulated for this condition, because obviously as little as possible should be left to be done in action, and it is not always an easy matter to fasten the fuze hermetically in the shell when under fire.

jectiles are intended to act in horizontal or low angled fire, as round shot first, and to run the chance of bursting among some of the troops in the second line or reserve of an army drawn up in battle array; with high-angled fire from short howitzers, the shell is intended to fall and rest upon the surface of the ground, and then burst. This nature of fuze has been adopted, then, for those projectiles, because it has been assumed as a principle that in the present state of knowledge on the subject of fuzes, there exist no system by which the moment of explosion can be satisfactorily altered under fire. The general type of this fuze is shown in section. (Plate 16, fig. 1) It consists of a truncated cone, or, more usually perhaps, of a combination of that figure with a cylinder of wood pierced through its axis to within a short distance of the bottom, into which is driven a composition of mealed powder; or mealed powder, saltpetre, and sulphur, in various proportions. The apex is hollowed into the shape of a cup to contain the priming, which usually consists of a paste of spirit and mealed powder or of a couple of strands of quick match* covered over with that paste. It is graduated exteriorly, showing the length of the fuze composition, and as the ingredients of that composition are so proportioned as to burn a known or given length per second, the fuze may be cut off with a knife or saw at the length which will burn for a period of time equivalent to that of the flight which the shell is intended to take. The bevel or whistle shape, as it is termed abroad, is the usual one to which the fuze is cut, as it exposes a larger surface of the composition. It might be supposed that the resistance which the shell meets from the air would fan the flame into quicker combustion; but by experiments made by the French Artillery at Toulouse in 1840, it has been proved that fuzes burn sensibly at the same rate whether at rest or in motion.*

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* To the uninitiated in Artillery matters, it may be necessary to explain that quickmatch is composed of a few strands of loosely twisted cotton, steeped in starch, and afterwards sprinkled over with gunpowder, reduced to an almost impalpable powder. It burns very quickly.

At the siege of Cadiz in 1809, the French used large mortars† which ranged up to 6000 metres (6562 yards, or 3·7 miles); the shells were nearly filled with lead, but had a certain space left for the bursting charge. To burst the shells at such great distances, it was requsite to make a short fuze which should burn a long time. This was thus managed:—in a short wooden fuze three channels were bored parallel to each other, communicating with each other by short channels at right angles; they were driven with composition in the usual manner, and the holes which were necessary for driving, but useless afterwards, were closed with wooden pegs. This is an interesting experiment, and is here recorded as circumstances might some day require a recurrence to so ingenious and simple a proceeding.

It has been stated above that naval fuzes come into the category now under consideration. In Her Majesty's service they are of brass, and are screwed into the shell: they are of three lengths and burn 20, 7½, and 2 seconds respectively. They are protected by metallic caps, which, for safety, are only unscrewed when the shell is actually in the piece.

They have certain advantages over the wooden ones, viz.:—they resist the vicissitudes of climate better, are less liable to accident, the shell bursts with greater violence in consequence of the diameter of the fuze hole being less, and they protrude less beyond the surface of the shell. The 4 inch or 20 second fuze may be cut with the slitting saw or bored up with the fuze augur. The 3 inch or 7½ second fuze may be bored up, but not cut.‡

2. *Fuzes timed and fixed in action.*—This class includes

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* Aide, Memoirs a l' usage des Officiers d' Artillerie, 1851, page 173.

† One of these mortars, termed "Villautroys" from their inventor, is now in the park opposite the Horse Guards.

‡ Sir H. Douglas on Naval Gunnery.

the common fuze when the augur or saw is used to bore or cut it in action. They are rarely used, and exceptionally only at sieges. In the field they may be considered as inapplicable in their simple form, though in a modified one they are used in several countries. This modification generally consists in having the wooden portion of the fuze fixed, but the composition moveable. The Norwegian Artillery employ the "Helwig" fuze, consisting of the usual truncated cone of wood, with the bore extending to within a short distance from the bottom of the fuze, where it diminishes in diameter, though preserving the same axis; at the bottom of the smaller bore there are two transverse channels meeting it and conveying the flame to the powder of the charge. The composition is driven in paste board cases and is primed with quick match. The field Artillery of this Power have three fuzes timed and fixed before hand: the uncut ones are intended for long distances only. The composition tube, which adheres to the sides of the wooden channel by friction, is cut at a suitable length just before firing.

The Belgian fuze, invented by Captain Splingard of the Artillery of that Power, much resembles it; the tube being of paper instead of copper. The wooden part of the fuze is fastened into the shell by being driven in, covered with a piece of greased leather, thus rendering the joint fire tight.

The channel for the reception of the composition tube is bored through the wood, and at about half an inch from its upper orifice it is widened out to double the diameter, and made to slope gently inwards towards the top. This enlargement is to hold a cork, having a hole bored through it, into which the composition tubes fits hermetically. This fuze has been found to answer very well in practice; but it appears to effect nothing more than is done by the simple ready cut British fuze, and that in a complicated and expensive manner.

Captain Boxer's fuze, which has lately been introduced into

Her Majesty's land service, is of this class. It is now so well known in England that it will probably suffice to descirbe it cursorily without entering into any great detail. It is the ordinary wooden fuze (*vide* Fig. 2, Plate 16, a section through one powder channel), with the composition channel bored excentrically with regard to the exterior. The bore reaches within a quarter of an inch of the bottom of the fuze. Two powder channels are run from the bottom within three quarters of an inch of the top, so that the end of the channel is on a level with the commencement of the fuze composition.

Communicating with these powder channels is a series of holes bored through the wood at right angles to the axis of the fuze. They are so bored that those communicating with one channel shall be at the even number of tenths of an inch of fuze composition, and with the other at the odd numbers of tenths. The fuze composition is the ordinary one. The side holes are filled by first running wires up the powder channels, and putting a small quantity of powder into each, the whole of one row of holes are compressed at a stroke; the still empty portion of them is filled with clay and pressed in like manner. The powder channels are then filled with rifle powder. The side holes perform the office of guiding the awl of the borer (an ingenious and simple little instrument *ad hoc*). The number of tenths of fuze requisite for any given length of flight being fixed upon, the awl of the borer is entered in at the side hole, the thumb screw acting on the awl is turned; by which means the awl pierces through the side hole, through the powder channel, and through the portion of wood which divides the latter from the fuze composition, thus making the communication complete between the charge in the shell and the fuze composition at the desired length, and doing away with all the apparatus of saw, fuze-augur, &c. The bottom side-hole is pierced through in all fuzes before hand, so that the shell bursts at the long range, if unpierced elsewhere. It is primed with two strands of quick match at the top, one short piece from the cup to the commencement of the composition, and one piece at the bottom (*vide* section). With this fuze, in the first instance, the bursting charge was contained in a tin-cylinder, into the end of which the fuze was thrust. Afterwards the shell was cast with a sheet iron diaphragm dividing it into two parts, the one containing the charge, the other the bullets; and this seems to be an advantageous arrangement. At the same time it should be remarked, that the centres of gravity and of figure of the shell will not coincide, and that, consequently, this will have its influence upon the flight of the projectile. It would not be difficult, perhaps, with this diaphragm shell to place the centre of gravity in that position in the bore of the piece which is known to produce the longest range; and if we are rightly informed, this is a point which has been hitherto overlooked. A brass bouching is screwed into the fuze hole, and into this bouch the fuze is fixed.

This fuze is a decided improvement upon the former system in use with the British Artillery, and may be said to be the best wooden fuze in existence.

3. *Fuzes timed beforehand and fixed in action.*—This is the system which, until a year or two back, has been in use in the British Service ever since the adoption of shrapnell shells. The fuze was simply the common fuze cut or bored to various lengths, each shell having four fuzes allotted to it, three being previously cut and one uncut. They were carried in pouches round one of the men's waists, at which the Prussian General Decker is pleased to be merry, saying that the unfortunate soldier so bedizened had more the appearance of a charlatan than of a warrior. They were marked according to their length by streaks of various coloured paints, thus indicating their length at the first glance. This system sounded much better in theory than it acted in practice; for, though

it might answer very well for a morning's curtain practice, still it was found to be rather a nervous thing to go into action with a large portion of the battery's ammunition requiring certain adjustments before it could be made use of. The consequence was, as far as the experience of the writer of this paper goes, and from the reports which have reached him from others, that on the eve of an action the system was abandoned and the fuzes were at once set home, selecting those which would answer to the distance at which the battery would probably (!) be engaged. Owing to the great number of hollow projectiles made use of by British field Artillery (upwards of 25 per cent, of the whole of their ammunition), fuze setting is a matter of the greatest importance, and yet for years the method above mentioned has obtained, only, as has been said, to be proved useless just before going into action !

The same system is pursued in Prussia with shrapnells, but they bear but a small proportion to the rest of the ammunition.

4. *Fuzes timed in action and fixed beforehand.*—To this class should belong the perfect fuze yet to be discovered, as do several ingenious fuzes which have been invented, but which, from their want of simplicity and expensive nature, have been found not to be of practical utility. Major William Olpherts, of the Bengal Artillery, some years back proposed one which, at first sight, was recognised by every one under whose consideration it came as having the highest claims to be largely experimented upon. This intelligent and distinguished Officer, there is no doubt, was *an* inventor of this fuze ; but, if any additional proof were required of the truth of Solomon's aphorism, that there is nothing new under the sun, here would be found one ; for Captain Moritz Meyer, of the Prussion Artillery, had in 1836, or twelve or thirteen yerrs previously, hit upon the very same idea.

Major W. Olpherts' fuze may be thus described : It is composed of two concentric Gun metal cylinders (Vide F. 3, Plate 16), the one within the other. It will be observed that the outer one has a screw tapped on its head, which is a little larger than the body, whereby it is fastened into the shell. It has a cylindrical hole bored through it, which is widened at the apex to nearly double the diameter. This bore is to contain the other cylinder presently to be described. A cut with a saw is made through one side of the cylinder, reaching into the bore. This cut was afterwards, in improved specimens, covered with thin sheet copper, forming a pipe open towards the slit. The interior cylinder (Fig. 4 Plate 16) has a head and body adapted to the hollow in the other cylinder, into which it fits closely. It is about one quarter of an inch longer than the other, and has a hole near the bottom at right angles to the axis, into which a pin is introduced, thus fastening it into the interior tube. It is further pierced down the axis to receive the column of composition, and terminates at its upper extemity in a cup for the priming powder and quickmatch. The upper surface of the composition is at such a height that the first tenth of an inch of composition should clear the edge of the metal of the shell. Holes are then bored through the cylinder at each tenth of an inch, not on a genitrix of the cylinder, but spirally round it. The fuze composition being driven and primed in the usual way, the inner cylinder is placed in the outer, and the pin driven into the former at the bottom, to keep it in its place. The combined cylinders forming the fuze are then screwed into the shell. The graduation (Fig. 5 Plate 16) is effected on the upper surfaces of the fuze, and resembles a clock face. An index mark is traced on the surface of the exterior cylinder on the same genetrix as the slit and powder tube above described, and marks are made on the upper surface of the interior cylinder corresponding to the positions of the holes at each tenth of composition. On the exterior are two square notches into which the teeth of a turnscrew fit to fix the fuze into the shell, and a similar pair of notches on the inner cylinder, which are likewise turned by a similar key, the only one necessary to be used in action.

With these arrangements made, the Officer, having estimated the distance, adapts the key and turns the interior cylinder round until the line representing the requisite number of tenths of fuze coincides with the index line (in the fig., No. 4 line coincides with the index, and, consequently, the shell would burst after the consumption of $\frac{4}{10}$ of fuze); or, in other words, causes the hole bored through the interior cylinder at the requisite number of tenths of fuze to coincide with the slit and powder tube. As soon as the fuze burns down to that hole, the fire rushes through it into the powder pipe, and through it into the bursting charge.

Captain Moritz Meyer's fuze is precisely the same, with the exception of the manner of fixing the interior into the exterior cylinder. The writer of this paper has been given to understand that a somewhat similar fuze is to be seen in the Repository at Woolwich but he knows nothing of its antecedents.

Major W. Olpherts fuze has made admirable practice. The shells were brought to the ground with the fuzes fixed, and the length of burning of the fuze was regulated with the greatest quickness, ease, and precision. Its advantages are great, but the objections to it are not less. The expense is ten times as great as that of a wooden fiuze. To meet this, it has been urged that no expense is too great provided that the fire is rendered effective, which it often is not at present; that with it each shell has but one fuze, whereas under the old system there were four, three cut to different lengths, and one spare uncut. There were, besides, a number of implements, such as fuze-augurs, saws, mallets and setters, scale, compasses, &c., which were carried with the battery, and which are unnecessary with this fuze, and thus expense would be saved. But a still greater objection to it is, that the workmanship must be of the most accurate description; the interior cylinder must fit the exterior one in every position so as to be fire tight, and this is a result which it must be hopeless to expect when made in large numbers. If the workmanship is defective in this point, the flame gets down between the two cylinders, and premature explosion is the consequence. Again, the pin running through the bottom of the interior cylinder must bear tolerably strongly against the end of the exterior cylinder, otherwise the shock of the explosion of the charge would be likely to disturb the timing of the fuze. Perhaps, however, with machinery expressly devised, this accuracy might be obtained, but it is a doubtful matter. It has been said, too, that it could not be used at night without a light; but this holds good with all fuzes, except those of the first class.

Another ingenious fuze, whose inventor is unknown, is thus contrived:—An ordinary wooden fuze has a thin cylinder of metal passing through the fuze composition. The fuze is driven on a spindle, like a rocket, leaving a hollow to receive the metal rod. This rod is graduated in that part which is immersed in the composition. The fuze being fixed in the shell, the rod is drawn out until the graduation indicates the requisite number of tenths. By this means it is obvious that as the rod is drawn out a hollow in the composition is left, through which, when the combustion has reached it, the flame is communicated at once to the charge. This is admirable in theory again, but most defective in practice. It is absolutely impossible to secure complete contact between the rod, after it has been once moved, and the sides of the composition, and, consequently, the fuze burns irregularly, and premature explosion is the result.

Parizot's fuze, used for the few shrapnells employed by the French, and which are fired from their howitzers only, has been pronounced by the famous Prussian artillerist Decker, to be the worst of all fuzes. It belongs to the class we are considering, and is worthy at least of a passing notice. It is a wooden fuze, with the bore extending to within half an inch of the bottom. It is pierced laterally with three holes, corresponding to a flight of two, three, and four seconds; the lowermost remains open, while the other two are closed by brass wires, which, after reaching the composition through the holes, are bent at right angles, and are then conducted in grooves in the sides of the fuze up to and beyond its head. The fitting of the wires is rendered hermetic by bees-wax, both in the grooves and in the lateral holes. The fuze is fixed in the shell, and if it is to be fired at the furthest distance, the lowest hole being open, it reqnires no further adjustment. But if at a shorter, one or other of the wires is seized in a split in the head of the priming wire, and, using it as a lever, the brass wire is pulled out of the hole, but not out of the groove, otherwise the fire might pass down the space left empty by it.

The fuze invented by Captain Bormann, of the Belgian Artillery, is one which has engaged the attention of the continental Artilleries for a number of years. If first appeared in print in the "Journal des Sciences Militaires" par Corrèard, 2 me sèrie, tom, 16 (1836) p. 273. It is unique of its kind, and contains perhaps the principle upon which the perfect fuze may yet be invented. The following description of it is compiled and condensed from the account given of it by M M. Turquem and Favè, and from that of Colonel Bormann himself:—

The body of the fuze is made of an alloy, composed of three parts of tin and one part of lead, which is melted into a brass mould, and which is of the form indicated in Fig. 6, Plate 16 a plan of the top; Fig. 7, Plate 16 a section; and Fig. 8, Plate 16 a plan of the bottom.

a. b. is a groove concentric with the outside of the fuze, made from below and reaching very nearly through the metal. A is a cell for the reception of the priming of quick match and mealed powder *c* is a channel communicating with the groove and the chamber filled with powder *d*, which, on explosion, fires the charge in the shell.

To charge the fuze, a piece of quick match is introduced into the channel *c*, nearly closing it, one end communicating with the groove and the other with the powder chamber. The latter is then filled with powder and is covered with a tolerably thick disk of lead, which, after being varnished over, hermetically seals it. The composition of the fuze is of mealed powder, a constant quantity being accurately weighed for the purpose. It is poured into the channel and carefully spread everywhere of an equal depth, a plate of lead of a suitable shape being placed on it, it is pressed by an instrument *ad hoc*, one stroke of which compresses the composition and two the lead. At first this plate of lead was a thin one, and the still vacant part of the groove was filled with melted lead; it was afterwards found better to fill it by compression entirely, the heat of the melted lead having possibly some effect on the burning of the fuze. The instrument used for compression which is probably of the same nature as those used for coining, cuts the graduation as shown in fig. 6.

As yet there is no communication between the priming cell and the composition. For this purpose the lead of the bottom of the cell, immediately over the composition (shown by the dotted lines at the left hand corner of the cell, fig. 6) is cut out and filled with quickmatch; the rest of the cell is filled with mealed powder, and the whole is covered with a plate of lead as described for the powder chamber. It is then varnished. The graduation is likewise covered with a transparent varnish to preserve it.

The fuze is supported in the shell by a circular sheet iron plate, with a hole in the centre to permit the flame of the fuze to communicate with the powder. It has two grooves round its exterior surface, which have not been shown in the section, because, in the first instance, they were square grooves, and afterwards angular ones like the female thread of a screw; and it is uncertain which have been retained, though we believe the latter. The fuze hole has similar grooves which are made in the casting. Their object, in both cases, is to hold the mastic which fixes the fuze into the shell. The fuze is fastened into the shell with plaster, (sulphate of lime) liquified in vinegar. This method is found to be fire tight, and to withstand the jar of ricochet fire. The shrapnell shells used in Belgium with this fuze are charged in such a manner as to render them excentric—that is, that the centre of gravity should not coincide with the centre of figure. This is for the purpose of obtaining a wider range; but as it does not form part of our subject, it will not be entered into here.

To uncap the fuze the leaden cover is torn off, and if it is intended to be fired at the longest distance, namely fourteen half seconds, the shell is ready to be placed in the piece.

If, however, it is to be fired at a shorter range, the lead of one of the divisions is opened with a chisel made for the purpose, care being taken to place the square edge of the instrument on the graduation. This is an operation effected in an instant, for the metal above the composition, as may be seen in the section, is very thin.

This fuze must be considered the most perfect one hitherto invented. As it has been seen, its great advantage of admitting of being timed after it is fixed is dependent upon the happy idea of placing the composition horizontally instead of vertically as in all other fuzes; and if a greater length of composition should be required, it is by no means necessary that the groove for the composition should form a portion of the curve of a circle, but it may be made to follow that of a helix or spiral. The manufacture of this fuze has greatly improved since its first invention, and possibly it may be capable of still further amelioration. It has been found to be both inexpensive (1½d. each in Belgium) and safe both in manufacture and in practice.

As the fuze composition, priming and powder chamber, and the joint of the fuze and shell are hermetically close, the fuze is preserved from atmospheric injury both from within and without. The top of the fuze being even with the surface of the shell must be enumerated among its advantages.

Critics have objected to it, that the priming powder is only of use when it is intended the fuze should burn its whole length. In answer to this, it may be said that priming powder or quickmatch is in no way necessary to the inflammation of the fuze, an assertion which personal experience, and the following confirmations by persons who may be considered high authorities on the subject, fully warrant. Captain Martin de Brettes, of the French Artillery, from whose work on fuzes we have extracted information, says, with reference to this apparent fault of Bormann's fuze :—"The priming is unnecessary ; experience has proved it with ordinary fuzes. Its properties are purely mechanical, for its only use is to prevent a rough surface to the flame, which is easier to kindle than a smooth surface. However compressed the composition may be, it only requires to be slightly scratched to take fire (from the charge of the piece) probably always." Captain Moritz Meyer, an Officer of the Prussian Artillery, who has published an excellent work on pyrotechny as well as others of a professional nature, says of the quickmatch, " that it is hurtful, because it destroys the hardness of the top of the column of the composition, from whence it results that that portion may be knocked out of the fuze composition channel, and the charge of the projectile be not inflamed."

It appears, however, that Bormann's fuze has met with opposition, or has been found not to answer in some (to us) unknown respect, for Captain Splingard's invention was made to replace it.

One great objection to it is, that all the shells now in existence would probably be useless, as the fuze hole requires to be very large, and it is a question whether the smaller natures of shells could afford to have so large an orifice bored in them.

5. *Percussion or concussion fuzes.*—These fuzes are only applicable to naval or sea coast Artillery shells. They exist at the present day in Her Majesty's navy in Moorsom's shell, and in the French in that of Billette. It has been thought necessary in both services to keep the nature of these fuzes a profound secret. And why? Because it is said that any power which gives its inventions of this nature to the world, more particularly in time of war, is teaching its enemies how, to cut its throat. Is this sound reasoning, or is it a little remnant of barbarism—of the days in which "Roman Catholic soldiers and interlopers" were forbidden to enter our laboratories? The secrets of the laboratory, like state secrets, will ooze out; and, if they did not, the first month of hostilities would blurt them out to the enemy with every detail. A grand mystery has been made for years as to the construction of our shrapnell shells—we allude to the first quarter of this century; and all this mystery never prevented their being experimented upon and given up as useless by most of the continental nations. When the *Tiger* went ashore near Odessa, we heard an officer of the navy, not very far from the spot, lamenting, not so much the loss of the gallant crew and the vessel, as the chance of the discovery of Moorsom's shell! Why, when our troops landed at Kertch, one of these shells, unexploded and complete in every way, was found stored in the museum of that town as a curiosity; and if the invention has all the excellent qualities attributed to it, we may depend upon it that the fleet at Cronstadt is pretty well prepared in that particular long ere this.

The Russian infernal machines afford another instance of the futility of attempting to keep such secrets. Further, is it such a difficult matter to construct a percussion or concussion fuze, or is it a novelty in pyrotechny? We hope to show that it is neither the one nor the other. Impressed with these convictions, we have not hesitated in this and a former paper to give every necessary detail of the construction of Captain Boxer's fuze, which must be tolerably familiar to the Russians by this time, as a number of specimens have been sent to them from our batteries, or of our friction tube.

Sir Howard Douglas thus defines the difference between the terms "percussion" and "concussion" as applied to shells or fuzes. "A concussion fuze is provided with an internal mechanism so nicely adjusted as to withstand the first shock which the shell receives—viz., that occasioned by the explosion of the charge—and resist any other that may be occasioned by grazing shot, while it shall yield to the concussion occasioned by the impact of the shell on the body struck; this concussion, by shaking the burning composition of the fuze into the loaded cavity of the shell, instantly causes the latter to explode. 'A percussion' fuze or shell is fitted or filled with a chemical composition of highly explosive character, which bursts the shell at the moment of striking, without being previously ignited."

The first "concussion" fuze, to adopt this somewhat arbitrary definition, that we know of, was the invention of a certain William Wilton in 1784. It is thus described in the British Indian Military Repository:—

"The construction of this fuze is very simple, it being only a common fuze altered as described below.

"AB (Fig, 9 Plate 16) is a side view of a common fuze completed with the alterations necessary to make it burst a shell on its striking the object.

"CD is a section of the same through the line AB. To make this fuze, the wood of a common one is cut away (about the depth of half its thickness) on two opposite sides to receive *a* and *b*, which are two small pieces of brass or gun metal, of such thickness as not to project beyond the exterior line of the fuze.

"The shape of these pieces is shown separately at E, F, and G, which exhibit the forms of the front, side, and upper end.

These pieces of brass are each perforated with a small hole, and this is slightly countersunk on the exterior surface of the metal.

" A hole is then drilled through the wood of the fuze, passing through the middle of the composition; a patch of thin leather is to be placed under each piece of brass, and a piece of copper or brass wire *e*, is to be passed through the holes and riveted in the countersinks of the pieces *a* and *b*, until the whole are brought into firm contact. The fuze is then complete.

" This simple apparatus effects its purpose from the following causes :—

" When brass or copper wire is red-hot, it is, if possible, more brittle than glass. The inflammation of the fuze composition during the flight of the shell produces the necessary ignition of the wire; and on the shock which the shell receives on its striking the object, the weights *a* and *b* fall off into the shell, carrying with each of them the end of the wire which was riveted into it. The fire of the fuze then finds vent at the two lateral orifices left open by the wire, and the explosion of the shell takes place."

The editor of the periodical from which the above description has been extracted, a highly scientific Officer of Artillery, says that he has tried the fuze and he never knew it to fail. It will be observed that a live shell, armed with this fuze, is as safe as though with a common fuze, for the concussion apparatus is out of gear, so to speak, until the fuze has been lighted, which is more than can be said of some other percussion fuzes; and that there is no chance of the shock of the explosion of the charge bursting it at the mouth of the piece, for the same reason. It has, however, the disadvantage of exploding when the shell grazes, whereas Moorsom's are said not to be affected by grazes.

Colonel Thiroux, of the French Artillery, the author of one of the best modern works on Artillery, invented a percussion fuze, which, though ingenious, requires the shell to strike the object fuze foremost, a condition he should have first found means to secure before proposing the fuze. We shall not describe it, as this fault makes it of no practical value, but content ourselves with saying that the explosion is effected by the friction of a cylindrical rubber, which is free to move in a small tube filled with a friction powder placed inside a wooden fuze with an otherwise empty bore. The head of the rubber being struck, it acts on the powder and ignition is the consequence. Those who shall be found rash enough to adopt such a fuze will suffer by it, we opine, more than their enemies.

A better fuze, which is superior to the last, but, in consequence of its complication, must be considered inferior to the simple apparatus of William Wilton above described, is the invention of Captain Martin de Brettes, of the French Artillery. It is thus constructed (Fig. 10 Plate 16.)

"A is a short wooden fuze, having a column of composition B, through which is a small hole, about $\frac{1}{10}$th inch in diameter. Through this hole passes a string, one end of which is fastened to the loop of the rubber F, while the other extends into the cup, where it divides into two, and passes through two holes to the exterior of the fuze; they are wrapped round a groove made for the purpose, and the ends tied. C is the cup filled with fuze composition and primed with a couple of strands of quickmatch. The bottom of this cup is covered with a thin coating of wax to prevent the fire from communicating with the composition in the bore B. D is a small wooden tube filled with fulminating composition. This tube is supported by two brass wires which surround it, the ends of which, after having passed through the fuze, are wrapped round a neck made for the purpose. It is well to run a cut with a saw across a diameter of the fuze up to the holes for the wires, as this facilitates the putting the tube D into its position. F is the friction apparatus, composed of a leaden bullet and of a rubber made of brass wire, flattened and serrated towards its end. This wire is double in order to increase the rubbing surface, and to leave a loop to which is attached the string (or wire, fusible at a low heat) and the better to bind it to the leaden bullet.

" It may be seen by the figure that the rubber cannot determine the explosion of the shell when the piece is fired, because the string (or fusible metal wire) prevents the rubber from moving in the direction necessary for the friction. When the piece is fired the composition in the cup kindles, burns the string which passes through it, softens the wax, and the rubber is then free to act. When the shell strikes the object, it is suddenly stopped in its course, and the leaden bullet having an impetus in the same direction as the shell had, would, if free, continue the motion; but, being restrained by the rubber, its force is exerted on that rubber, which it pulls into the detonating composition, and thus fires the charge."

We must leave our readers to form their own judgement upon the merits of this ingenious fuze, as our limits compel us to bring this paper to a speedy close. We cannot do so, however, without alluding to the fact of the adoption in the French service of a friction fuze for hand-grenades.

The fuze is a wooden one driven with the usual composition, but having a little wooden tube inserted, filled with friction powder with a brass wire rubber inserted into it. The grenade is thrown in the usual manner; but to fire the fuze, a string, with a hook at the end, attached to a leathern bracelet, is connected with the rubber of the fuze, which is drawn when the projectile leaves the hand, and thus fires it.

We have described a number of fuzes, some of which may suggest improvements to those who have the time and opportunity to experiment upon this important branch of pyrotechny, which may be said to bear the same relation to the shell that the heart does to the body, or the slide-valve to the steam-engine. A perfect fuze, or a fuze as nearly perfect as anything sublunary can be, is still a desideratum; and he who shall discover one will deserve well of his country. One of the first steps towards such an invention will, we opine, be the adoption of an instrument whereby the fuzes may be filled by pressure instead of by hand, for however well practised a workman may be, it cannot be expected that he will always strike blows of exactly equal strength, and without this it is in vain to expect regularly burning fuzes. The machine for pressing percussion cap charges, combined with that for loading them, might be made to fulfil the object in view. In conclusion, we would once move direct the attention of artillerists towards the great advantages which would probably accrue to shrapnell shells, if their excentricity were taken advantage of to secure longer and more regular ranges.*

M. L.

Haddan's improvements in Cannon.

Mr. J. C. Haddan, of Westminster, has recently patented an invention which consists, firstly, in casting cannon hollow with any desired form of grooves or rifling, and with any desired amount of inclination or twist (whether such inclination be uniform or otherwise throughout the length of the cannon.) The manner in which this is performed is as follows :—A tubular or hollow metal core, which is formed externally of the shape intended to be given to the interior of the cannon, is provided with the means of keeping up a continual circulation or change of water within it, for the purpose of keeping the core cool, and giving a chilled surface to the interior of the cannon. Secondly, in manufacturing cannon by casting the mass, or greater portion of the metal of which they are composed, upon or around a permanent hollow mandril, or core, or lining (for the cannon) of comparatively thin substance, such mandril, core, or lining consisting either of one piece only, or of two or more pieces or sections, longitudinally or otherwise, and its interior being formed to the intended shape of the bore of the cannon, whether rifled or otherwise, either previously or subsequently to casting the mass into or around its exterior. The manner in which that is performed is as follows, the hollow mandrill, or core, or lining, being called the tube. In order to insure a firm and solid fitting of the tube, so that the concussion of firing may be less likely to displace or loosen it within the cast iron, its exterior is made with longitudinal corrugations, flutings, or flat surfaces, which, however, are considered to be unnecessary throughout the entire length, and therefore it is preferred to turn off or remove them at intervals, and thus cause a firm hold or fitting of the cast metal upon the tube longitudinally as well as transversely*

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* United Service Magazine, February 1856.

Constructing Mortars and Ordnance.

To the Editor of the Mechanics' Magazine.

Sir,—I take the liberty of submitting to you for insertion in your Magazine, a brief description of a new mode of constructing mortars or heavy ordnance. I may mention, that a small model has been submitted to several scientific gentlemen for their consideration, some of whom think it would answer, while others think not; and in the absence of actual experiment, its publication at the present time may not be out of place.

I propose therefore to have cast in the shell of mortars, or other ordnance, circular perforations extending longitudinally from the mouth, to a short distance beyond the breech. The perforations to be midway between the inside and outside of the shell. If the mortar to be cast is required to throw very heavy shot, perhaps two or three rows of perforations may be found requisite, to keep the mass of metal as uniform as possible, and to give greater strength to the shell itself.—By this means it is proposed to do away with the cancellated or spongy nature of large masses of metal, and to effect, what has been found up to the present time impracticable, the casting of large ordnance.†

BUSBY, NEW GLASGOW, 5th March 1856. I am &c.

THOMAS ALMGILL.

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* Mechanics' Magazine 8th March 1856.

† " " 15th " "

Exercise of Rockets.

The 24 pounder is used for siege-purposes. The 12 and 6 pounders are for service in the Field.

EXERCISE OF 12 AND 6-POUNDER OR FIELD ROCKETS.

Telling off the Detachment.

The detachment falls in, in rear of and facing the carriage, and is told off as for Gun exercise.

"*Form the order of march, Left face.*"—No. 1 shifts along the front to the left flank, and heads the front rank. At "*Quick march,*" the front rank countermarches to its right and marches on the right side of the carriage; the rear rank wheels to its right and marches on the left side of the carriage. No. 1 halts in line with the point of the off shaft; 2 and 3 in line with the rear of the hind wheels; 4 and 5 in line with the front of the hind wheels; 6 and 7 in line with the axletree of the limbers; the whole at the distance of one yard from the wheels, and covering.

Disposition and Duties of a Detachment of seven men, with a 12 and 6-pounder Rocket.[*]

No. 1 stands 1 yard in rear of the tube, points, and commands.

3 stands on the left of the tube, in line with its centre, elevates and traverses.

5 stands on the left of the tube, in line with the rear of it, primes and fires.

7 stands in rear of the carriage and prepares rockets. When firing shell rockets, he bores out the composition, assisted by No. 6.

2 stands on the right of the tube, in line with its centre, elevates and traverses.

4 stands on the right of the tube, in line with the rear of of it, brings up rockets, arranges the priming and loads.

6 stands in rear of the carriage, assists No. 7 in preparing rockets. When firing shell rockets he puts in the bursting powder &c.

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[*] With the 3 Pdr. Rocket, only 5 men are required:—No. 5 performing the duties of No. 7 and No. 4 those of No. 6, in addition to their own.

The following is the proportion of Stores furnished with Field Carriages.

Two hundred and sixteen rockets with sticks.	with 6 Pounder
Two hundred and sixteen bursters.	
One hundred rockets with sticks.	with 12 Pdr.
One hundred bursters.	
One rocket tube.	with both natures.
One rocket frame, comprising two cheeks, a pry pole, elevating bar, and tangent scale.	
Two funnels.	
One boring stock.	
Two boring bits.	
One brass scale fitted to bits.	
Two turnscrew bits.	
One grease box.	
One tube pocket with tubes.	
One lanyard with hook for friction tubes.	

To every other equipment not exceeding 144 *Rockets.*

One rocket tube with frame.

One stick for each rocket.

One burster ditto.

Two funnels.

One boring stock.

Two boring bits.

One brass scale fitted to bits.

Two turnscrew bits.

One grease box.

One tube pocket with tubes.

One lanyard with hook for friction tubes.

One angle.	with 24 Pdr.
One plummet with line.	
One elevating chain.	
Two guy ropes.	
Two additional pieces for the cheeks.	

On field service the bursters are carried in the limber boxes, in canvas cartouches similar to those in which the field ammunition is carried. The 12 pounder rocket carriage takes 50 bursters in each limber box, and the small stores in a box on the body of the carriage corresponding to the slow match box. The 6-pounder carriage takes 108 bursters in each limber box, and the small stores in a box which is between the limber boxes. In mountain equipments the bursters and small stores are carried in a box fitted to the pack saddle.

For garrison service and occasional demands the bursters are issued in packing cases, and the small stores in a box made for the purpose.

Coming into Action.

A rocket detachment may come into action to the front, rear, right, or left, in the same manner as a field gun detachment; the rocket carriage going to the rear and covering the rocket tube, as directed for the field gun limber, at the word "*Drive on.*"

At the word "*Action front, rear, right or left,*" Nos. 2, 3, 4, and 5 unstrap the rocket tube and lift it to the rear of the carriage; 2 and 3 lower the foot of the prypole to the ground, and then, with 4 and 5, raise the front of the tube and point it in the named direction. As soon as the tube is clear of the carriage, No. 1 gives the word "*Drive on,*" 2 and 3 adjust the cheeks and fix the elevating bar at its highest elevation, 4 and 5 adjust the prypole, 1 ships the tangent scale, and 6 and 7 proceed to the rear with the carriage to prepare rockets, &c.

At drill without horses there must be two additional numbers to remove the carriage with Nos. 6 and 7.

Loading.

At the word "*Load,*" No. 4 doubles to the rear, receives a rocket from 6, brings it up and inserts about one half of the rocket in the tube at the rear. He then loosens the priming, pushes the rocket in beyond the springcatch, and draws it gently back till it is stopped by the spring.

Pointing and Laying.

At the word "*Elevate,*" No. 1 sets the tangent scale for the required elevation and then takes hold of the rocket stick with both hands, draws back his right-foot, and looks over the tangent scale; 2 takes hold of the elevating handle and eases the screw; 3 takes hold of the tube at the frapping with both hands, backs down. At the word "*Lower,*" No. 3 allows the rear of the tube to descend. As soon as 1 perceives that the muzzle has the proper elevation, he gives the word "*Halt,*" and 2 immediately fixes the elevating bar screw.

At the word "*Muzzle right, or left,*" No. 2 takes hold of the right cheek with his right hand, and the prypole with his left; 3 takes hold of the left cheek with his left hand, and the prypole with his right; and the two numbers together shift the rocket tube under the direction of 1, who, when he has taken his line, gives the word "*Halt.*"

If further elevation be required, it is given in the manner already described.

Priming and Firing.

As at field guns.

In firing at columns of infantry or cavalry in motion, in order to obtain increased rapidity of fire it may be of advantage to have an additional man, whose duty it will be to bring up rockets, and place them in a convenient position for 4.

As at exercise the rocket is put into the tube, it is necessary to unload; an operation exactly the reverse of loading.

To Limber up.

At "Front rear, right, or left limber up,"—the carriage comes up as directed for the limber at field gun exercise; No. 1 unships his tangent scale and puts it into its place; 2 takes hold of the elevating handle and eases the screw, and 3 lifts the bar out of the groove. Nos. 2 and 3 then close the cheeks and elevating bar to the prypole and, with 4 and 5, lift and strap the rocket tube on the carriage.

Twelve-pounder and Six-pounder rockets are sometimes fired from the ground, either singly or in vollies. Both the rocket and stick are supported a little above the ground, upon any suitable thing that may be at hand, the rocket somewhat higher than the tail of the stick. The priming is loosened, and, if a volley is to be fired, the rockets are laid a few inches apart and a train set from rocket to rocket. One rocket is then fired with a port fire.

EXERCISE OF 24-POUNDER OR SIEGE ROCKET.

Disposition and Duties with Seven Men.

When the detachment is in action, the disposition and duties of the numbers are the same as at the lighter natures.

To carry the frame.—No. 2 carries the right cheek, and 3 the left. No. 4 carries the front of the rocket tube, and 5 the rear. No. 6 carries the top of the prypole, and 7 the foot.

The rocket tube and frame ought only to be carried when the distance is short. When the distance is long, they ought to be drawn in a hand cart.

To put the frame together, at low order.—Nos 2 and 3, on their proper sides of the tube, raise the tops of their respective cheeks, over the middle of it, to a height of about two feet. Nos. 4 and 5 hold up the top of the prypole between the cheeks; the foot of it to the rear of the tube; the holes of all three in a line, ready to receive the bolt. No. 6 puts the bolt through the holes, and 7 puts on the nut. When this is done, Nos. 4, 5, 6, and 7 raise the top of the cheeks and prypole about 5 feet from the ground. They then hook the elevating chain, 6 and 7 passing it over the top of the prypole to 4 and 5, who hook it to the centre of the tube.

To raise the frame.—Nos. 2, 3, 4, and 5 bring the feet of the cheeks towards the foot of the prypole, the top of which is raised by 6 and 7, and the foot pressed to the ground by 1. The frame is thus raised until the top of it is about 10 feet from the ground. The command is then given, "*Reeve the Guys—sling the rocket tube—and fix the angle*"—upon which Nos. 2 and 3 reeve the guys through the staples of the cheeks; 4 and 5 raise the rear of the tube until the bolt at its extremity is opposite to the hole in the prypole, the front of the tube still resting on the ground; 6 puts through the bolt, and 7 puts on the nut; 1 fixes the angle and suspends the plummet.

To adjust the frame.—Nos. 2and 3 stand to the feet of the cheeks. Nos. 4, 5, 6, and 7 raise the front of the tube by hauling upon the elevating chain, and when it is sufficiently high, 1 hooks the chain to the elevating bar. Nos. 4 and 5 then stand to the cheeks with 2 and 3, and 6 and 7 stand to the prypole. Under the direction of No. 1 the cheeks and prypole are shifted until the plummet-line indicates 30 ° upon the angle, the feet of the cheeks 10 feet asunder. When the frame is thus adjusted, No. 1 replaces the angle and plummet, and the numbers fall in at their respective posts.

Loading.—As directed for the 12 and 6-pounders.

Traversing.—If very little alteration in the direction of the tube be required, it may be given by means of the guys, which are manned by 2 and 3. If the direction is to be changed to the right, at the command "*Muzzle right,*" No. 2 hauls the right guy, whilst 3 gives the left guy to a corresponding extent. If the direction is to be changed to the left, the command is "*Muzzle left,*" and the duties of the two numbers are reversed.

If greater alteration be required than can be given by means of the guys, at the command "*Cheeks to the right, or left,*" Nos. 2, 3, 4, and 5 move the cheeks of the rocket frame in the named direction, whilst 6 and 7 steady the prypole; No. 1 stands in rear with the plummet, as directed for mortars.

Elevating.—When it is necessary to alter the elevation

Nos. 2 and 3 haul the elevating chain and 1 shifts the hook, in the elevating bar.

Priming and firing.—As directed for field guns; but No. 5 mounts upon the steps of the prypole in order to drop in the tube.

Raising the frame to the high order.—When the frame is fixed at *low order*, the prypole forms an angle of 30° with the horizon, which is the highest elevation at which a rocket can then be fired. If greater elevation than this be required the frame must be raised to *high order.* The command is therefore given "*Prepare to raise the frame to the high order,*" upon which 2 and 3 cast loose the guys and, with 4 and 5, take hold of the cheeks; 6 unhooks the suspending chain and, with 7, lowers the muzzle of the tube to the ground. No. 1 then gives the word "*Join the cheeks.*" Nos. 2, 3, 4, and 5 raise the feet of the cheeks from the ground; 6 and 7 support and steady the prypole close to the rear of the tube. When the feet are sufficiently high, 4 and 5 support the cheeks and 2 and 3 join the additional pieces to them, on their respective sides, and bolt them. The command is then given to "*Raise the frame,*" whereupon 2, 3, 4, and 5 bring in the cheeks and 6 and 7 raise the prypole, until the top of the frame is about fourteen feet high. No. 1 fixes the angle and suspends the plummet.

To adjust the frame.—The frame is shifted as at low order, until the prypole is at 45° of elevation, as shewn by the plummet-line upon the angle, and the feet of the cheeks thirteen feet apart.

With the frame thus adjusted rockets can be fired at any angle up to 45°. If still greater elevation be required, the foot of the prypole may be moved inwards until the prypole forms an angle of 50° with the horizon.

"*Prepare to strike the frame.*"—Nos. 2 and 3 cast loose the guys and stand to steady the cheeks. Nos. 6 and 7 unhook the elevating chain, lower the tube to 4 and 5, and stand to the prypole. Nos. 4 and 5 lower the muzzle of the tube to the ground, and take post under and facing the cheeks, ready to receive them.

To strike the frame.—Nos. 6 and 7 grasp the prypole firmly and walk with it gently to the rear, keeping the foot of it close to the ground. Nos. 4 and 5 walk backwards to the top of the frame, supporting the cheeks, and turning themselves by degrees so as to front the cheeks when lowered. Nos. 2 and 3 keep the feet of the cheeks from moving. When the frame is nearly down, Nos. 6 and 7 move forward and assist 4 and 5 in supporting the top, and 1 then carries the foot of the prypole to the rear until the frame rests upon the ground. As soon as the frame is struck, it is taken to pieces by the same numbers that put it together.

PREPARING ROCKETS (DUTY OF NOS. 6 AND 7.)

To prepare a shell, No. 6 holds the rocket steady in a horizontal position, (supporting it between the spokes of the wheel and against the side of the carriage, when there is one). No. 7 takes out the screw plug with the turnscrew bit, and then replaces the turnscrew with a boring bit, adjusted, in the manner hereafter described, to suit the length of composition to be bored out. He inserts the boring bit, through the plug hole, into the cup of the fuze, and turns the stock from left to right until the collar of the boring bit is against the head of the rocket. He then withdraws the boring bit, and whilst he replaces the turnscrew bit No. 6 inserts the funnel in the plug hole and pours in the bursting charge. No. 7 then replaces the screw plug and screws on the stick, taking care that the screw of the latter enters fairly, and is not forced.

If the rocket is to be used as a shot rocket, No. 7 must take care that there is no powder in the shell, and that the plug is secured in the plug hole. The stick is screwed on as above.

To use the Boring Bits aud Scales.

The composition of the fuzes for the 24 and 12-pounder rockets being of the same diameter, one boring bit serves for the two natures. The same is the case with 6 and 3-pounders. One brass scale also serves for the 24 and 12-pounders, and one for the 6 and 3-pounders, the graduations suited for the different natures being marked on opposite sides of the respective scales, as shewn in the accompanying diagrams.

On each side of either diagram are two scales, graduated to tenths of inches. The larger (extending from D to E) has reference to the fuze composition, and the shorter (extending from B to C) has reference to the rocket composition. The first lines of both scales (marked respectively E and C) are zero; the next lines to them denote $\frac{1}{10}$th; the next $\frac{2}{10}$ths; and so on. At the extremity A is a raised shoulder. In order to set the bit for boring out any particular length of composition, it is laid along the scale with its point resting against the shoulder. The collar is then brought to the longer or shorter scale (according as the fuze composition only or the rocket composition is to be reduced,) and being set to that line which corresponds with the length to be bored, it is screwed tight to the bit. The boring bit should always be greased. The distance from A to B is equal to the greatest length of composition, (fuze and rocket together) which should, under any circumstances whatever, be bored out.

Notes.—When there is much wind from the front, rockets should be fired with half a degree more of elevation than in still weather; when from the rear, with half a degree less than in still weather. They must at all times be laid to leeward, with a deflection proportionate to the strength of the breeze and distance of the object. Great attention must be given to these points.

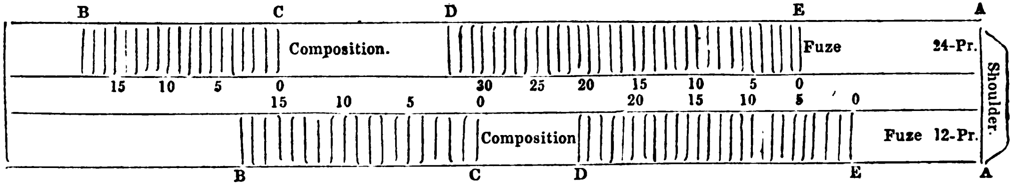
Great care also must be taken in screwing on the sticks so as to secure a true poise, and in the adjustment of the tube after each round.

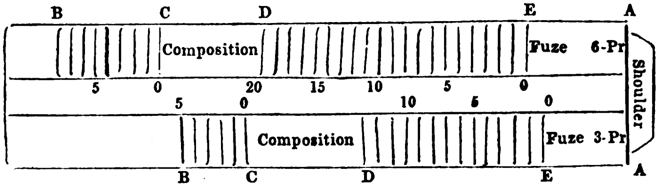
A B is the greatest length which the Rocket Composition can be bored into, so as to leave 1·5 inch over the end of the Cone in the 24-Pounders, and 1 inch in the other natures.

A B is in the 24-Pounder, 7·8 inches :
in the 12-Pounder, 6 2 inches ;
in the 6-Pounder, 4·7 inches ; and
in the 3-Pounder, 3 inches.

A D is the distance from the surface of the shell to the inner extremity of the Fuze, and is—

in the 24-Pounder, 4·9 inches ;
in the 12-Pounder, 3·5 inches ;
in the 6-Pounder, 2·9 inches ; and
in the 3-Pounder, 2 inches.





B C is the thickness of the Composition available for boring into, after leaving the above thickness over the Cone and is—

in the 24-Pounder, 1·8 inch ;
in the 12-Pounder, 1·8 inch ;
in the 6-Pounder, ·8 inch ; and
in the 3-Pounder, ·5 inch.

D E is the length of Fuze, and is—

in the 24-Pounder, 3·3 inches ;
in the 12-Pounder, 2·5 inches ;
in the 6-Pounder, 2 inches ; and
in the 3-Pounder, 1·3 inches.

ctiles.

Plate 17.

Fig. 3.

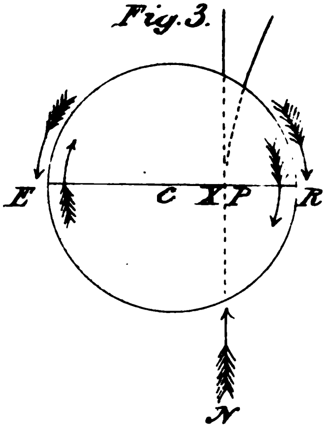
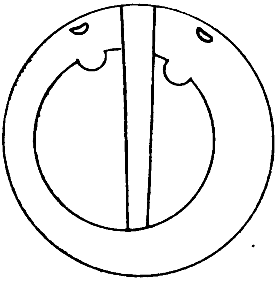


Fig. 5.



W.P.E. Lith.

A B is the greatest length which the Rocket Composition can be bored into, so as to leave 1·5 inch over the end of the Cone in the 24-Pounders, and 1 inch in the other natures.

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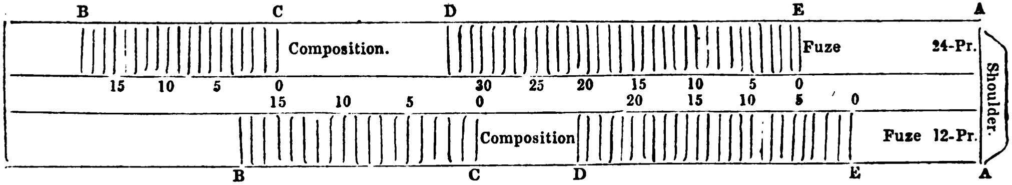
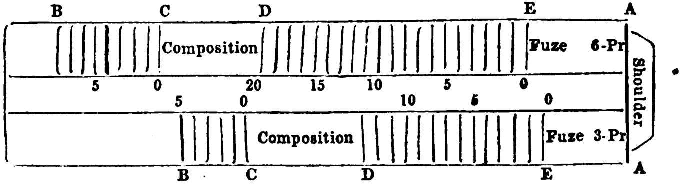




B C is the thickness of the Composition available for boring into, after leaving the above thickness over the Cone and is—

in the 24-Pounder, 1·8 inch ;
in the 12-Pounder, 1·8 inch ;
in the 6-Pounder, ·8 inch ; and
in the 3-Pounder, ·5 inch.

D E is the length of Fuze, and is—

in the 24-Pounder, 3·3 inches ;
in the 12-Pounder, 2·5 inches ;
in the 6-Pounder, 2 inches ; and
in the 3-Pounder, 1·3 inches.

ctiles.

Plate 17.

Fig. 3.

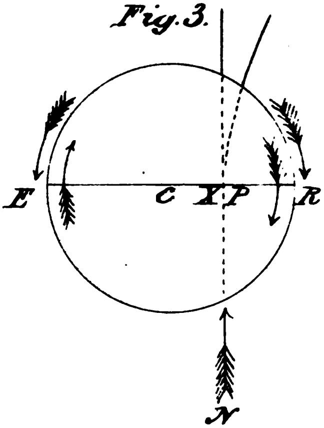
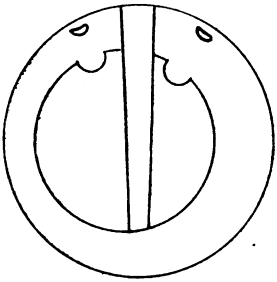


Fig. 5.



W.P.E. Lith.r

On the Revolution of Projectiles.

The great improvements which have been made in rifled arms during the last 10 or 15 years, particularly as to length and accuracy of range, have naturally turned the attention of artillerists generally to the amelioration of their ordnance. Rifling the bores of their pieces was of course an obvious suggestion, as a means of increasing the range and rendering the practice more accurate. The grand difficulty met with, was the nature of the metal of which their projectiles are made. In the rifle, the metal of the piece is harder than that of the bullet; while in the gun, howitzer, or mortar, that of the projectile, in the case of brass ordnance, is the hardest, and in that of iron guns it is of equal hardness. It was impossible to compress the projectile into the grooves of the piece, and, to meet this difficulty, studs to fit the grooves, and other contrivances of an analogous nature, have, from time to time been essayed, but invariably without success. Lancaster's gun seemed to effect the desired object. Its construction is well known. The bore, instead of being in section a circle, is an ellipsis of small eccentricity, and its general run has a twist, which gives the projectile a motion of revolution, thus assimilating it (the piece) to a rifle, and throwing a projectile similar in shape to the Minié bullet. The practice of these pieces, however, is by no means certain, and it seems that the extra expense attending their manufacture, and more particularly that of the projectiles, which are of wrought iron, is hardly compensated by their superior effect. They appear to be more liable to burst than guns of the ordinary construction.

The means whereby modern rifles attain the accuracy and great range are to be reduced to two improvements upon the smooth bore—the first is a method of controlling the revolution of the ball, so as to ensure its revolving in the same direction at every shot; the second, of exploding the powder in such a manner in rear of the ball, so that in every case it shall act in a uniform direction and with greater effect. The former is attained by rifling the piece, and thus compelling the ball in its exit therefrom to follow the spiral direction of its grooves; the latter, by abolishing the windage, in various ways—either by causing the ball to swell out by blows from a heavy ramrod, while the lower side of it rests on a steel pillar affixed to the interior of the breech, or producing the same effect by using the elastic force of the gas of the exploded powder, to expand the ball in like manner.

The revolution of the ball from a rifle is necessarily in the same direction as the spiral of the grooves—if it is grooved "with the sun," the ball will revolve in the same direction, namely, from left to right; if "against the sun," from right to left. But there are two other normal directions in which the ball might revolve, if we could only discover some means of compelling it to do so, namely: the anterior part upwards or downwards. What then would be the effect of such a revolution? It is our wish to lay before our readers both the means by which this has been attained, and the effect produced by it.

But it is well that we should first study the theory, as explained by different authorities, of the rotation of projectiles:—

"With respect to bodies projected in artillery practice, which are supposed to be homogeneous and perfectly spherical, the centre of the shot cannot deviate from the vertical plane passing through the direction of its initial velocity, and relatively to which every thing is alike on all sides. But if the projectile deviates a little from the spherical form, or if it has not the same density throughout its entire extent, the resultant of the exterior resistances which are normal to its surface will not pass *constantly* through its centre of gravity; it will, consequently, produce a motion of rotation; and if it is not always comprised in the vertical plane in which the centre of gravity commences to move, it will cause it to deviate from this plane; so that the trajectory of the projectile, referred to its centre of gravity, will no longer be *a plane curve.* It is easy to conceive all this when the projectile is neither perfectly spherical nor homogeneous; but it may be remarked that, even though the defect of perfect sphericity or of non-homogeneity be not taken into account, still, if the shot is actuated by any velocity of rotation at the mouth of the gun, *the friction of its surface against the air* during the motion may still cause its centre of gravity and of figure to deviate from the vertical plane.

" In order to shew this, let G, fig. 1, Plate 17, be the centre of gravity and figure of a spherical homogeneous body, and A G B the diameter which is a tangent to the trajectory described by G. Let us suppose, for greater simplicity, that the axis of rotation which passes through the point G is perpendicular to this diameter. Let A B D E be the section of the projectile, perpendicular to this axis, and D G E a diameter of this section, at right angles to A G B. Likewise let the motion of the point G be from A to B, in the direction indicated by the sagitta S, and the motion of rotation in the direction indicated by the sagittæ placed at A, D, B, E. The friction of each element of the surface against the air, which arises from the motion of rotation, will be a force acting along the tangent to the surface, in a direction contrary to this motion. On each section parallel to A B D E, it will vary from one point to another, in consequence of the difference of density of the fluid. The fluid will be condensed *before* the projectile, and it will be dilated *behind* it, consequently the friction will be greatest on the side of the point B, and least on that of the point A. Hence it follows, that if all forces arising from the friction exerted against the surface be transferred parallel to their directions to the point G, there will result a force acting along the point GD of the diameter DGE. Let this force be denoted by F, the weight of the body by P, the resistance of the medium transferred to the point G, and acting in the direction of GA, a part of the diameter AGB by R. The motive force of the point G will be the resultant of the three forces F, P, R, and its accelerating force will be equal to this resultant, divided by the mass of the projectile.

" This being established, if the axis of rotation be vertical, and, consequently, comprised in the plane of the two forces Pand R, GD the direction of the force F will be perpendicular to the plane; it will therefore cause the projectile to deviate from this vertical plane, by urging it on the side of the point D; and in this case, the trajectory of the point G will be a *curve of double curvation.*. If, on the contrary, the axis of rotation is horizontal, GD the direction of the force F, will be comprised in the vertical plane of the forces Pand R, which will be that of the section ADBE, consequently the point G will not deviate from this plane, and its trajectory will be a plane curve.

" It appears that in this last case the vertical component of the force F will increase or diminish the weight P, according as the direction of the sagitta A is upwards or downwards. The force F will be vertical, and this diminution or increase of weight will be a maximum when the direction A B is horizontal. Thus, in a horizontal level, if the shot be supposed to turn about a horizontal axis, perpendicular to the direction of the level, the friction of the projectile against the air will increase its weight and diminish the range when the anterior part of this body turns upwards, and when this part turns towards the horizon the friction will diminish the weight and increase the range. It may even happen in this second case that the trajectory becomes convex to the horizon, for, in order that this should take place, it would be only necessary for the rotation to be sufficiently rapid to render the force F greater than the weight P; but then, as the friction would diminish the velocity of rotation the force F would decrease and eventually become less than P, when the trajectory would again become concave towards the ground as usual."*

These are Poisson's conclusions as to the effect of rotation of a projectile on the trajectory, and it will be well to compress them into as few words as possible so as to enable us to compare them with those of other writers as well as with the results of practice hereafter to be detailed. We will suppose an observer to be standing at the breech looking towards the direction in which the projectile moves out of the piece, so as to be quite clear as to which is the right hand and which the left. Poisson holds then that:—

"1st. When the axis of rotation is *horizontal,* perpendicular to the direction of the level, and the anterior part of the body turning *downwards,* the range will be *increased;* and *mutatis mutandis, vice versâ.*"

"2d. When the axis of rotation is *vertical,* and the shot revolves from *right* to *left,* it will deviate from the plane of the normal direction, and be thrown to the *right;* and *mutatis mutandis, vice versâ.*"

The result here attained was adopted by all artilleries for many years, for to dare to question the authority of the great Poisson was held to be the height of presumption. According to Sir Howard Douglas, quoting from a foreign artillerist whose name he does not mention "In 1826 and 1827 experiments were made at Mayence (by the Prussians), to ascertain the effects of eccentricity, and it was stated that from these the theory of the flight of spherical projectiles was proved to be erroneous." The theory alluded to is doubtless that above exposed.

The Prussians do not appear to have been very communicative on the subject of their experience. In 1838, a number of experiments were made at Brasschaet, by the Belgian Artillery, giving results diametrically opposed to those come to by Poisson, and which were theoretically accounted for as follows :—

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* Poisson Traité de méchanique. Harte. Arts, 445, 446.

1st Case.—*Trajectory of a concentric* projectile having a rotatory motion.*

It is evident that such a projectile, in addition to the resistance of the air, properly so called, which in this case is normal, meets further with a resistance resulting from the friction of the air against its surface. Let us suppose the projectile to be divided into two lateral hemispheres, A and B, fig. 2, by a plane determined by the direction of the force N, with which the projectile is animated at a given point of the trajectory, and by the axis of rotation of the projectile ; we shall then see that the elements of the surface of one of these hemispheres, A, for example, should move in the same direction as the projectile is going, in virtue of its rotatory movement ; while the elements of the other hemisphere, B, on the contrary, make a retrograde movement with reference to the direction of the path of the projectile.

If, then, the projectile is animated with a velocity V, and if V' express the velocity which is communicated by the rotatory motion to the elements of the surface of the projectile, any given element of the hemisphere A will move with a velocity $V+V'$,† and the corresponding element of the hemisphere B, with a velocity $V-V'$; from which it results that the friction of the air upon the element of A will be greater than the friction on the element of B. All that has been said of an element of the surface being equally applicable to the entire surface, it is evident that the whole hemisphere A will meet with a greater resistance in the air than the hemisphere B; that the lateral force created by this resistance will be applied to the hemisphere A, and will continually drive the projectile towards the opposite side B, and that, finally, *the projectile will deviate from the normal trajectory* in the direction of the motion of rotation.* The resistance of the air in this case, then, produces a lateral force, composed of—1st, the resistance of the air, properly so termed, acting normally; and 2d, the surplus of the friction of the air on the side A.

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* "Concentric," that is to say, a projectile whose centre of *figure* and centre of *gravity* are identical.

† If v be velocity of translation v' the relocity of rotation, then $v = v'$ Sin θ will be the velocity of any particle situated on the equator of the sphere, θ being the angle between the direction of motion passing through the centre and the radius at whose extremity the particle is situated. The above expression has been suggested to the writer as the above sheets were written.

2D CASE.—Let us admit that the same projectile, by an irregular distribution of its mass interiorly, has an eccentricity CP, fig. 3, or in other words, that its centre of gravity P does not coincide with its centre of figure C; and that its linear and rotatory movements are precisely the same as before, at a given point of the trajectory; in this case we observe, that the axis of rotation does not pass through the centre of figure, as in the former case, for the known reason that that axis must be beyond the centre, in consequence of the inequality of the weight of the two *hemispheres* of the projectile, which we may conceive to be divided by a section at right angles to *the axis of equilibrium* ER; that is to say, the diameter ER of the projectile containing the two centres C and P, and which I have thus designated, because the mass of the projectile is *in equilibrio* about that diameter.

The axis of rotation always forming a right angle with the axis of equilibrium, must then pass through a point X contained in the axis of equilibrium between the centres C and P, and likewise the force N, with which the projectile is animated at the moment in question, must naturally be directed on this point X.

Let us grant further: that the point E is further from the centre of gravity than the point R; that the direction of the force N is at right angles to the axis of equilibrium; it follows that the *normal plane* of division, determined (as in the 1st case) by the direction of the force N and by the axis of rotation, in this case passing through the point X, divides the projectile, not into two hemispheres, but into two *lateral parts, unequal* in volume and surface, which we may conveniently designate by their culminating points E and R, the part E being the greater.

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* The imaginary curve which would be traced by a concentric projectile of the same weight, diameter and *cæteris paribus*, but having no rotatory motion.

Finally, let us admit that the part E revolves round the point X in the same direction as the linear motion of the projectile, so that the portions E and R respectively correspond to the hemispheres A and B of the 1*st Case;* it is evident that the phenomena already described will be analogously reproduced, with the exception that the effect of the friction against the air on the side E, will react proportionally with greater force on the projectile in consequence of the inequality of the number of elements which make up the surfaces E and R, and in consequence of the greater difference between the velocities of these elements in the direction of linear motion of the projectile.

Under these circumstances the friction of the air against the surface E will be greater than that on the surface R; that the portion E will displace a greater mass of air than the portion R, in virtue of its rotatory motion; and then the strata of air condensed in front of the projectile will be more compressed in front of the portion E than in front of the portion R, their density decreasing from the posterior summit of the projectile corresponding to the point N. From all this it follows of necessity: 1stly. that the retarding force, caused by the friction of the air, will be applied to the anterior portion of the surface E, forming an acute angle with the tangent to the trajectory curve; 2ndly, that the force created by the resistance of the air properly so called, will likewise be applied to the anterior portion of the surface E under an acute angle with the tangent to the trajectory; and 3rdly, that these two lateral forces will act in the same plane, that of rotation of the poles E and R round the point X; and that, finally, they will form the component forces of the lateral force, which in this 2d Case constitutes the real resistance of the air. I have already stated that this force will be always greater than that which we found in the first case for a concentric projectile.

Theory proves that the point X is situated closer to the centre of gravity P, as the eccentricity CP of the projectile becomes greater; whence it follows that the resistance of the air must increase, not only with the eccentricity of the projectile, but that its direction must form a proportionally larger angle with the tangent to the trajectory at the anterior part of the projectile, and, consequently, that the deviations of the trajectories from the normal trajectory curve must increase rapidly with eccentric projectiles as the eccentricity increases, although the augmentation thereof (of the eccentricity) be merely a very small quantity.

Let us now condense these results into a few words, as we did with Poisson's, in order to be able to compare them more easily. Bormann, from whom we have borrowed the above theory, then holds that:—

1st.—When the axis of rotation is *horizontal*, perpendicular to the direction of the level, and the anterior part of the body turns *downwards*, the range will be *decreased*, and *mutatis mutandis, vice versâ.*

2d.—When the axis of rotation is *vertical* and the shot revolves from *right to left*, it will deviate from the plane of normal direction, and be thrown to the *left*, and *mutatis mutandis, vice versâ.*

If, now, we compare these two statements of effect with those come to by Poisson at page 449, we shall find them diametrically opposed to each other.

Mr. Bormann, Lieut.-Colonel of the Belgian Artillery, in giving the above account of the effect of rotation, says that the first idea of it arose from supposing a current of air to be blowing in the direction opposed to that in which the projectile is moving, and following the line of a tangent to the trajectory. This current of air, he says, naturally divides itself into two parts, with reference to the normal plane separating the projectile into two hemispheres as above mentioned; the movement of rotation, considering it as superficial, goes necessarily on one side of this plane *against*, and on the other *with* the current—a circumstance which at once determines an excess of friction and of resistance on that side of the projectile which is opposed to the current. He submitted his theory, founded upon this supposition, to men whose knowledge of the mathematics was generally acknowledged to be of a high stamp, and they advised him to abandon the principle he had advanced, basing their counsel on the dictum of Poisson above given. He felt compelled to abandon it, because no experiments at that period had been of a sufficiently satisfactory nature to warrant his continuing to hold it. The first series of rounds at the Polygon of Brasschaet in 1838, however, caused him at once to resume it.

The Prussians have come to the same conclusions as M. Bormann and they account for them in this wise:—

Let the figure in the margin (Fig. 4, Plate 17) be a horizontal section of the bore of a piece of ordnance; let the centre of gravity *b* lie in the half B of the projectile, the half A receives an equal impulse from the force of the powder as the half B; but since A is lighter than B, it will be endowed with a greater velocity than the half B from the same impulse. But as both are indissolubly connected together, there follows a rotatory motion of the projectile towards that side on which the centre of gravity is situated; in the figure it will be to the right. And for like reasons if the figure be considered as a vertical section it will revolve from above to below.

We will now proceed to shew the results of practice carried on in various countries, and all with the same gist.

At Brasschaet in 1842, a number of rounds were fired by the Belgian Artillery from two howitzers of 15c. (5·9 in.), the one being a long, the other a short howitzer; the diameter of the projectile was in both instances 14·5c. (5·709 in.); charge, 0·5k. (1·1 lb.) Eccentricity of projectile 0·001 m.

(0·0039 in.): weight, 10·96k. (24·7 lbs.) With the short howitzer elevated to 10 degs., and placing the centre of gravity of the shell *below* the axis of the piece, the mean range of 5 rounds was 662·8 paces; the mean of 5 rounds fired with the centre of gravity *above* the axis, all other circumstances being the same, was 895·20 paces. With the long howitzers, with an elevation of 5 degs., an eccentricity of projectile, 0·0016 m. (0·0063 in.), the other conditions being similar to the above, the centre of gravity being *below* the axis, a range, the mean of 5 rounds, of 519·60 paces was attained, while with that centre *above* the range was 786·60.

At Shoebury-Ness a number of rounds were fired from a 32 pounder gun loaded with shot, having one pound of metal removed from one side so as to render it eccentric with a 10 lb. charge, and an elevation of 12 degs, the mean ranges attained with the centre of gravity *upwards* and *downwards* were 3,498 and 2,598 yards respectively.

In the above experiments the eccentricity of the projectiles was very small, and the experimentalists appear not to have thought it requisite to push the eccentricity to any great degree, though in some instances, in the last mentioned experiments, 5 lb. of metal was removed from the 32 lb. shot. The Prussians, on the other hand, have carried it much further. It has been found impossible to get exact dimensions to prove what the eccentricity is in the shells used by that power, but it must be large, as seen by the diagram in the margin, (fig. 5 Plate 17) copied from "Die Waffenlehre," Berlin, 1855. If the original diagram is correct as to proportions, the eccentricity must be as great as $\frac{1}{17}$th of the diameter of the shell. To ascertain the "light pole" of such a shell, it is floated in mercury. A disc of card suspended by a silken thread, and covered on its lower surface with white oil paint, is held by the hand over the shell and gradually lowered on to it, leaving a white dot, which is then formed into an arrowhead. The card is evidently a tangential plane to the sphere at the end of a diameter of a great circle, which passes through the centres of figure and gravity. When, then, the arrow-head on the shell is placed *upwards* in the piece, the centre of gravity is *below* the axis; and when it is placed *downwards*, that centre is *above* the axis.

We append an abbreviated practice table showing the effect of the two positions of the centre of gravity:—

Abbreviated Practice Table of the "low angle fire" of the 7-pdr. howitzer. Charge, 1·95 lbs.; calibre, 5·84 in.; length of piece, 6 to 7 calibres.

Distance.	With new Model Shells.	
	Arrow head upwards.	Arrow head downwards.
Paces.	Degs. of elevation.	Degs. of elevation.
700	3½	1
800	4¼	1⅛
900	5¼	1¼
1,000	6¼	1⅜
1,100	7½	1½
1,200	8¾	1¾
1,300	10	2
1,400	11¼	2¼
1,500	12¾	2½
1,600	14¼	2 5/4
1,700	15¾	3
1,800	17¼	3¼
1,900	19	3⅝
2,000	......	4
2,100	......	4½
2,200	......	5
2,300	......	5½
2,400	......	6⅛
2,500	......	6⅞
2,600	......	7⅝
2,700	......	8½
2,800	......	9⅜

The Prussian Pace is ·8237 yards, and the Prussian pound is 1·3 lbs. avoirdupois.

It will be seen, then, that to throw the shell 1,800 paces or 1,183 yards, with the centre of gravity below the axis, the piece requires an elevation of $17\frac{1}{4}$ degrees, while with that centre above the axis it requires but $3\frac{1}{4}$ degrees; and that $8\frac{1}{2}$ in the one case produces a range of 1,200 paces or 988 yards, while in the other it throws the shell up to 2,700 paces, or 2,223 yards.

Out of 180 shots fired against 2 walls of 6 feet high by 96 feet long, the first of which was at 1400 paces (1154 yards), the second at 20 paces (16·5 yards) behind the former, the following was the *per-centage* of hits :—

1. With the arrow-head *upwards* $21\frac{2}{3}$, with $23\frac{1}{3}$ holes in both walls, and $3\frac{8}{9}$ hits between them.

2. With the arrow-head *downwards* $21\frac{1}{9}$, with $26\frac{2}{3}$ holes in both walls, and $1\frac{2}{3}$ hits between them.

Out of 360 shots fired against 3 walls of 9 feet high, of which the first was at 1200 paces (989 yards), the others at 20 paces one behind the other, consequently at 1220, and 1240 paces respectively (1005 and 1014 yards), the following was the *percentage* of hits:—

1. With the arrow-head *upwards* $42\frac{2}{9}$, with $50\frac{5}{9}$ holes in the three walls.

2. With the arrow-head *downwards* $26\frac{17}{18}$, with 60 holes in the three walls.

Among the hits made with the arrow head *upwards*, $1\frac{7}{8}$ per cent. struck between the walls, while among those with the arrow-head below, not one single grenade had so struck.*

If we look upon the object fired at as a horizontal surface, we shall have more hits with the arrow-head *upwards* ; if, on the other hand, we look upon it as a perpendicular surface, the hits will be more numerous if the arrow-head be *downwards*.

To this must be added, that the ground effectively commanded with the arrow-head *upwards*, firing at 800 paces (695 yards), is about eight times greater than if the arrow-head were *downwards*. As 1,600 paces (1,318 yards), about 5 times greater,

The above are the remarks attached to the table, to which we shall add two more taken from another source, but connected with the Prussian Artillery, namely : that rate of rotation per second depends on the charge and upon the eccentricity of the shell, and that one of the howitzer shells with the largest charge of powder (1½ lb.), revolves 60 times in a second.

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* *Vide infra* where this is accounted for.

In order that we may form an opinion as to the accuracy of this practice as compared with that of concentric shells, let us see what the practice of the French 15c. (5·91 inch) howitzer is, as we have no tables of probability of this nature in the British service. We find it as follows, firing at a target 12m. by 2m. (or 39·4 feet by 6· 6 feet):—

		Number of hits per Cent.		
		500 m. or 547 yds.	800 m. or 874 yds.	1200 m. or 1312 yds.
15c. Howitzer.	Large Charge............	60	33	8
	Small Charge............	30	...	...

from which we must conclude that the Prussian practice is at any rate not bad, having the power however of extending it up to 2,307 yards as we have seen.

Having thus placed all the information we are possesed of as to the means by which the revolution of a projectile can be controlled in a smooth bore, we have now to consider for a few moments what has been gained by it. It amounts to this, that the range of a very short howitzer has been increased in a very high proportion ; that fired as a howitzer, it is effective up to 2,000 paces (1648 yards), and as a mortar up to 3,000 paces* (2,472 yards). That this result is attained by a method which appears to be perfectly practicable in action, as there is no more difficulty in putting a shell with an arrow-head painted on it into the bore in a particular direction, than there is in inserting a cartridge with the seam downwards.

It remains to be seen if the principle could not be applied to Shrapnell shells; if it can, it would provide the Artillery with a means of returning to the old existing proportions between their ranges and those of small arms.

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* *Vide* "On the use of Field-Artillery in Action." By Tawbert, Berlin, 1855. John Weale, 1856, pp 67 and 69.

Before bringing this paper to a close, we have to draw attention to the fact, that when such an eccentric shell is fired with the centre of gravity above the axis, the revolution engendered is unfavourable* to ricochet, as it tends to increase the resistance of the plane to the progress of the projectile; and that this may account in part for the larger per-centage of hits with the centre of gravity below the axis than with that centre above the axis, as seen in the remarks attached to the Prussian practice table above quoted.

One of our latest English writers on Artillery† enunciates the following opinion on eccentric projectiles:—

"It is not to be expected that eccentric projectiles would be applicable to general purposes, on account of the degree of attention and care required in their service, nor would much advantage be gained by their use, as the momentum is not altered, and it is only necessary to give the ordinary shot a little more elevation in order to strike the same object."

To this we would beg to remark with the greatest deference to so high an authority as the writer, that the degree of attention requisite in using the new Prussian shells appears, as we have stated before, to be no more than that required to put the cartridge in seam downwards; and that the argument he makes use of to prove that no great advantage would be gained is of no weight whatever, because it is by no means a matter of indifference whether a given object is struck by a projectile following a trajectory of little or great curvature, as the execution done by the former must evidently be infinitely greater than that by the latter.‡

M. L.

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* Sir H. Douglas, Naval Gunnery, p. 185. Third Edition.

† Captain Boxer, Treatise on Artillery, p 173. ¶ 351.

‡ United Service Magazine, April 1856.

Pugh's Fire Projectiles.

Among several promising inventions which have been submitted to the Government is a fire projectile invented by S. W. Pugh, Esq., of Nelson-square, Peckham, Surrey. Fig. 1 of the accompanying engravings (Plate 18) represents a section of this projectile taken through its longitudinal axis. A is a solid iron head with a hardened point. BB is a fire mixture of great explosive power—at least a thousand times that of gunpowder—contained in an outer case. When this case is burst, the greater part of the mixture, B, which is of the nature of liquid fire, is scattered abroad, emits destructive fumes copiously, and burns upon water or any other substance with which it comes in contact. C is a steel rod, of about 1 inch in diameter. It has a hardened point, which will cut into iron, and carries in its other end a percussion cap. D is a similar rod with a nipple, on which the cap in C strikes, and which is furnished with two touch-holes. The cap is made to fit the nipple quite tightly. EE is an inner iron case, containing explosive powder, of either slow or rapid ignition. F, fig. 2, is a safety cap for protecting the point of the steel rod, C, thus preventing all danger. This cap is taken off when the projectile is placed in the gun or mortar from which it is discharged. G is a steel screw, which screws into the head, A, and has a fine screw inside to hold the steel rod, C, and a screw outside to hold the safety cap, F. When the projectile strikes an object, the fine thread on the inside of the screw, G, is broken, and the cap in C, is driven down upon the nipple on D, causing instant explosion, by which the liquid fire is scattered, and the iron-head, A, impelled forward.

It is clear, that by the arrangement adopted in the construction of this projectile, the enormous waste resulting from the bursting of the ordinary shells in the air would be avoided.

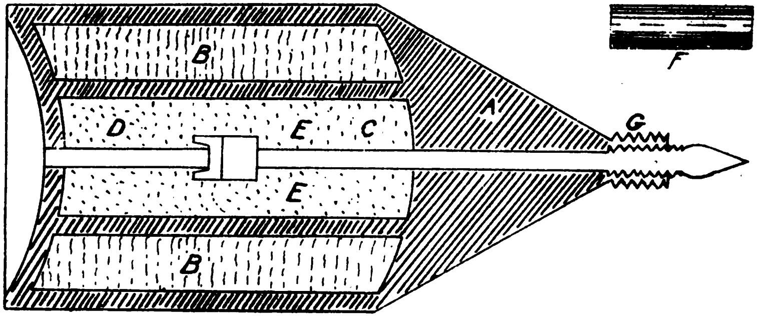
Mechanics' Magazine, 16*th February* 1856.

Selections.

Page 460 — Plate 18

Pugh's Fire Projectiles.

FIG. 1. FIG. 2.



Madras Artily Depôt. Printed by N. Spencer W.P.E. Lithr

EXERCISE OF THE CYLINDRICAL PONTOON, ACCORDING TO THE PRACTICE OF THE ROYAL ENGINEER ESTABLISHMENT, CHATHAM.

Royal Engineer Establishment,
Chatham, 25th June, 1852.

It having become necessary to reprint the Pontoon Exercise, some trifling alterations will be found, which are more in Form than in Details.

As it is very desirable to simplify the Drill as much as possible, the Detachments attached to the Carriages have been regulated in such a manner, that when the Pontoons and Stores are unpacked ready for forming Bridge, the same Detachment should form the Crew of the Raft carried on the Carriage to which they have been originally told off.

The Exercise is divided into two parts, "Packing and unpacking the Carriages," and "Forming a Bridge," which can thus be practised separately.

Those Officers who have had experience in marching with a Pontoon Train, are well aware of the great importance of having every thing on a Carriage properly and securely packed, in order that no interruption to the march, and consequent delay to a whole Column may arise, from the necessity of making a halt to repack any of the Stores which may have become deranged by the motion of the Carriage.

To the proper packing of a Carriage the greatest attention therefore is required from the Officers and Non-Commissioned Officers attached to a Pontoon Train, who ought personally to inspect the several Lashings of each Carriage every morning before moving, in order to ascertain that every thing is secure, and in its proper place; inattention to these particulars may occasion great delay and retard the movements of Columns of Troops, which may be moving on the same Line of Road, but in rear of the Pontoon Train, and the Pontoons may fail to reach the spot where a Bridge is to be formed at the appointed time.

The word "Port" having been adopted in the Royal Navy instead of the word "Larboard," the same Rule is now observed in the Pontoon Exercise, and the word "Larboard" will be found omitted.

(Signed) HARRY D. JONES,
Colonel Royal Engineers,
Director.

PONTOON BRIDGE,
RAFTS,
GENERAL EQUIPMENT,
&c.

PONTOONS are hollow cylindrical vessels of tin, which being perfectly water tight, possess from their shape great buoyancy, and are used for forming Bridges for the passage of rivers by Armies in the Field.

A Pontoon consists of a cylinder 19 feet 6 inches in length, by 2 feet 8 inches in diameter, with parabolic ends, each 2 feet 6 inches long; the total length of a Pontoon is consequently 24 feet 6 inches.

Pontoons are usually formed of sheet tin, of the description and quality known in the trade as × × ×, framed round a series of light wheels constructed of tin, having hollow tubes of one inch diameter for the spokes; the axis, a hollow tin cylinder $1\frac{3}{4}$ inches diameter, running through the entire length of the Pontoon.

The Pontoon is internally divided into nine distinct compartments, perfectly water tight and independent of each other. It is provided with four rows of sunken handles, placed at intervals of 2′ 1″ round the circumference, for the purpose of lashing the Saddles which are placed on it, and form the bearing of the Baulks which support the superstructure of the Bridge, each end has a stout iron ring securely attached to it.

SINGLE RAFT. *Two Pontoons,* with their allotted superstructure and Stores, form a Single Raft.

DOUBLE RAFT. *Two Single Rafts,* connected together, form a Double Raft, on which heavy Artillery can be conveyed across a River, Pontoon Bridges are formed by the connexion of Rafts in sufficient number to reach across rivers of moderate width, and are connected with the banks by means of temporary staging or landing places.

A Pontoon Bridge, so formed, is capable, (under several modifications of structure) of sustaining the passage of Heavy Artillery and Stores, and Troops of all Arms of the Service.

The Saddle of a Pontoon is a framing of fir, 12 feet in length, 1 foot 2 inches in breadth, and 3 inches in depth, which is placed lengthwise on the centre of the Pontoon, and secured to it by lashings, to receive the ends of the Baulks extending from Pontoon to Pontoon.

Baulks are likewise of fir timber, 14′ 2″ in length, 4½″ in depth, and 3″ in breadth, placed in position from Saddle to Saddle, and being secured to them by means of iron pins or bolts, form the supports of the flooring of the Bridge or Raft.

Whole Chesses, which form the floor of the Bridge, consist of three fir planks, connected together by four cleats on the under side, and are 11′ 5″ in length, 2′ 1″ in breadth and 1½″ in depth.

Half Chesses consist of a single plank 11′ 5″ in length, 1′ 0½″ in breadth, and 1½″ in depth, strengthened by cleats in a similar manner to the whole Chesses, and are placed over the Saddles in order to afford ready access to the pins, &c.

Each Raft is furnished with 2 Saddles, 12 Baulks, 10 whole Chesses, 4 half Chesses, 1 Anchor and Cable, 6 Oars for rowing, and 1 Oar for steering, 1 Buoy Line, and 1 Breast Line, 1 Boat-hook, and a proportionate number of Lashings.

A Pontoon Carriage is a four wheeled Carriage with a perch, and bolsters over the axletrees, and is capable of carrying a Raft and its Stores.

TABLE OF STORES CARRIED ON A PONTOON CARRIAGE.

	No.	DIMENSIONS.			WEIGHT.		
		Length.	Breadth.	Depth.	cwt.	qrs.	lbs.
Pontoons	2	24′6″	2′8″	2′8″	10	0	10
Baulks	12	14′2″	0′4½″	0′3″	5	1	22
Chesses	10	11′5″	2′1″	0′1½″	8	2	18
Half Chesses.	4	11′5″	1′0½″	0′1½″	1	1	16
Saddles................	2	12′0″	1′2″	0′3″	1	1	27
		Shank	Flukes	to Flukes			
Anchor................	1	3′10″	2′0″	0′1	...	1	27
Buoy	1	2′ 0″	0′10″	0′10″	...	...	5¼
Cable, 30 Fathom ...	1	180′ 0″	0′3″	Rope	...	2	7
Oars....................	7	14′0″	......	......	...	3	24¾
Boathook	1	16′0″	......	......	...	...	9
Body Lashings.......	3	8′9′	0′4″	Webbing	...	...	20
Saddle Lashings......	4	15′0	0′1″	Rope	...	...	5
Carriage Lashings....	4	22′0″	0′1″	Rope	...	...	7
* Rack Lashings.....	8	6′0″	0′2″	Rope	...	...	5
* Rack Sticks.........	8	1′0′	0′1½″	0′1½′	...	...	5
* Buoy Line..........	1	60′0″	0′1″	Rope	...	...	5
* Breast Line.........	2	60′0	0′1″	Rope	...	...	10
* Outriggers	2	11′5″	0′4½″	0′3″	...	2	20
Carriage Weighs	...	......	......	......	13	3	20
Total Weight...	...	......	......	......	44	1	1

The Baulks are the first Stores packed, these are placed on the centre of the Bolsters, which are cut to receive them, so that when laid in their proper places the top of the Baulks and the Bolsters are level; the Chesses are placed immediately over them, the two Saddles are laid over the Chesses, and the Cable stowed between the Saddles; the two Pontoons are then placed on the Saddles, the Oars being packed over the Cable between the underside of the Pontoons; the Anchor and Buoy is securely lashed to the perch of the Carriage.

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* These are packed in the Carriage Box, not being used until the Bridge is formed.

Pon

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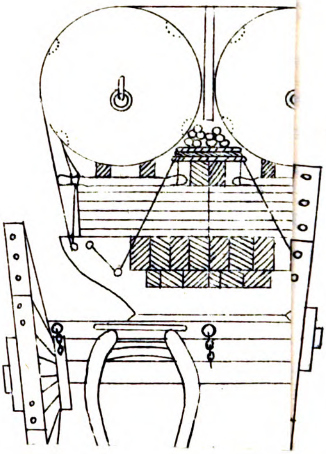
Front Elevati



The Pontoons and Stores are secured to the Carriage by webbed girths, which are passed over the Pontoons and lashed down to the Carriage.

DETACHMENTS FOR PONTOON CARRIAGES.

The men belonging to the Pontoon Train are told off in Detachments of 6 men, (with a Non-Commissioned Officer where one can be spared), and each Detachment of 6 has charge of a Carriage with its Pontoon and Stores.

The Officers are distributed by the Commanding Officer according to their number amongst the different Carriages.

The Carriages are numbered from Right to Left.

The Stores being laid out on the ground, and the Men drawn up in Line in rear of the Carriages, the following instructions detail the mode to be adopted.

TO PACK THE CARRIAGE.

WORDS OF COMMAND.	
Number by Threes, from the Right. *Threes, Left Wheel, Quick March.* *Halt. Dress.*	The front rank men are the Left Section, and the rear rank the Right Section.
Non-Commissioned Officer's number Detachments from front to rear.	The men will then be proved, until each Non-Commissioned Officer and Private knows his number, and how they are told off.
Form up on your respective Carriages, Right face, Quick March.	The Detachment will be marched right in front along the rear, and will be halted in succession behind their respective carriages.

No. 1, Right Section, halts in line with the off fore wheel.
„ 2, „ „ covers him between the wheels.
„ 3, „ „ do. 1 and 2, in line with the off hind wheel.
„ 1, Left „ halts in line with the near fore wheel.
„ 2, „ „ covers him between the wheels.
„ 3, „ „ do. 1 and 2, in line with the near hind wheel.

Prepare to pack the Carriages.

Collect Stores.

The Right Section lays out.	1 Pontoon 1 Saddle 5 Chesses 2 Half Chesses 6 Baulks 4 Oars 2 Outriggers 1 Cable 1 Anchor 1 Buoy	To the right side of the Carriage.

and

The Left Section lays out.	1 Pontoon 1 Saddle 5 Chesses 2 Half Chesses 6 Baulks 3 Oars 1 Boathook	To the left side of the Carriage.

They will also collect the following small Stores and Lashings, and place them in the Box in the front of the Carriage, *viz*:

3 Body Lashings.
8 Rack Lashings and Sticks.
4 Pins.
1 Breast Line.
1 Buoy Line.

4 Saddle Lashings.
4 Carriage Lashings.

The greatest care possible must be taken by the Non-Commissioned Officers in charge, that the above small Stores have been duly collected and placed in the Box; in the dark, men are in the habit of placing them on the ground, where they are liable to be lost. The Detachment will then fall in at their respective places on each side of the Carriage.

Pack the Carriage Baulks.

At the word "*Baulks,*" No. 1 Right Section will place himself at the front, and 3 Left Section at the rear of the Carriage, ready to pack the Stores, which the other four men from their respective sides of the Carriage will hand to them.

Four Baulks are placed flat on the bolsters of the Carriage, the other eight Baulks are placed edgeways on the former, and are bolted and keyed to the fore bolster.

Chesses.

At the word "*Chesses,*" No. 1 Right and No. 3 Left Section pack them, the other four men lift them on the Carriage.

Care must be taken, that the first Chesses are laid ledges uppermost, and flush with the front end of the Baulks. The next Chess is laid ledges downwards, and retired sufficiently for the ledges to be clear of each other, and so on alternately.

Saddles.

At the word "*Saddles,*" the left Detachment bring up one Saddle, and the right Detachment the other, placing the cleats downwards, the pins outwards, and within one inch of the outer edges of the Chesses.

Lash down Saddles.

Nos. 1 lash the Saddles to the fore bolster, and Nos. 3 to the hind bolster of the Carriage; the lashings are made fast to the inner rings on the bolsters in front of the fore bolster, and a turn taken round the outside horn of the belaying cleats of the Saddle; they are then passed through the ring and up through the hand holes of the Chesses, round the inner-horn of the belaying cleats, and again down through the hand holes of the Chesses at the rear of the Carriage, but outside of them in the front, then again through the rings, and are fastened by a frapping turn. Whilst Nos. 1 and 3 are thus employed, Nos. 2 lash the anchor and Buoy to the perch of the Carriage.

Outriggers and Cables. At the word "*Outriggers and Cables,*" No. 1 Right and 3 Left receive these Stores from Nos. 2 and 3 Right. Nos. 2 and 3 Right then hand up the Cable, which is laid on the Outriggers by the two men who pack the Stores.

Prepare to place Pontoon on Carriage. Upon this caution, the whole of the Detachment place themselves at equal distances on the outside of the Pontoon to be placed first on the Carriage. Two Baulks are then withdrawn from the Carriage for the purpose of rolling up the Pontoon on to it, one end of each Baulk resting on the superstructure which has been packed, and the other end resting upon the ground at an angle convenient for rolling the Pontoon on to the Carriage.

Roll Pontoon on Carriage. The Pontoon is then carefully rolled up the Baulks or to the Saddles, and the Baulks replaced on the Carriage.

Lash down Pontoons. Nos. 1 will lash the head and Nos. 3 the stern of the Pontoons by the handles of the Pontoons to the Saddles, round the back of the belaying cleats; No. 2 Left will assist at head, and No. 2 Right at the stern; after which

Nos. 1 and 2 will pass the Oars and Boat-hook between the Pontoons with the blade to the rear, and Nos. 3 will lash three Oars and the Boat-hook to one of the inner handles at the stern of the Pontoon, and three Oars to the other; great care being taken to secure the Oars, to prevent them slipping off the Carriage in travelling.

Pass the Body Lashings over the Pontoons.

No. 2 Left gets on the top of the Pontoons to adjust the Fenders attached to the Lashings; Nos. 1 and 3 pass the front and rear, and 2 Right the centre body lashing over the Pontoons, and as soon as the Fenders are adjusted No. 2 Left goes to his place at the side of the Carriage.

Make fast the Body Lashings.

Nos. 1 and 3 lash their respective ends of the Body Lashings to the two outer rings at the side of each end of the bolster of the Carriage, and Nos. 2 passing the respective ends of the centre lashing through the centre handles of the Pontoons, cross the ends to each other under the Baulks, and then through the triangular rings at the opposite side: the whole of the body lashings are made fast by a frapping turn.

TO UNPACK THE CARRIAGE.

Unlash and cast off the Body Lashings.

Nos. 1 Nos. 2, and Nos. 3, unlash and cast off their respective ends of the body Lashings. Nos. 3 then unlash the Oars from the inner stern handles of the Pontoons. No. 2 Left gets on the top of the Pontoons and disengages the Fenders.

The Left Section then fold up the body Lashings, and place them in the box at the front of the Carriage. They also withdraw the Oars and Boat-hook from between the Pontoons, and place them on the left side of the Carriage.

Unlash the Pontoon Lashings. Nos. 1 and 3 unlash the Lashings at their respective sides and ends of the Pontoons, No. 2 Left Section assisting at the head, and No. 2 Right Section at the stern. The Pontoons are then rolled steadily down on two Baulks placed as in packing them.

Unlash and dismount the Saddles. Nos. 1 unlash the fore lashings, and Nos. 3 the head lashings of the Saddles and dismount them, placing them alongside their respective Pontoons; Nos. 2 at the same time unlash the Anchor and Buoy, and place them on the right side of the Carriage.

Dismount the Stores. No. 1 Right places himself at the front, and No. 3 Left at the rear of the Carriage, ready to hand the Stores to the Right and left Nos. in the following order:

The Cable, and 2 Outriggers to the Right Nos. 5 Chesses, 2 Half Chesses, and 6 Baulks, respectively, to the Right and Left Nos. who will place those Stores on the ground on their own side of the Carriage, the Non-Commissioned Officers observing that they are neatly packed.

FORMING THE BRIDGE.

In forming the Bridge, the Detachment of each Carriage form the Crew of a Raft, whose number corresponds with the number of the Carriage. No. 1 Carriage becomes No. 1 Raft, and so on.

The Stores being unpacked and stored by the side of the River, the Bridge is now formed by launching successive Pontoons into the River, and placing the superstructure on them, this is termed—

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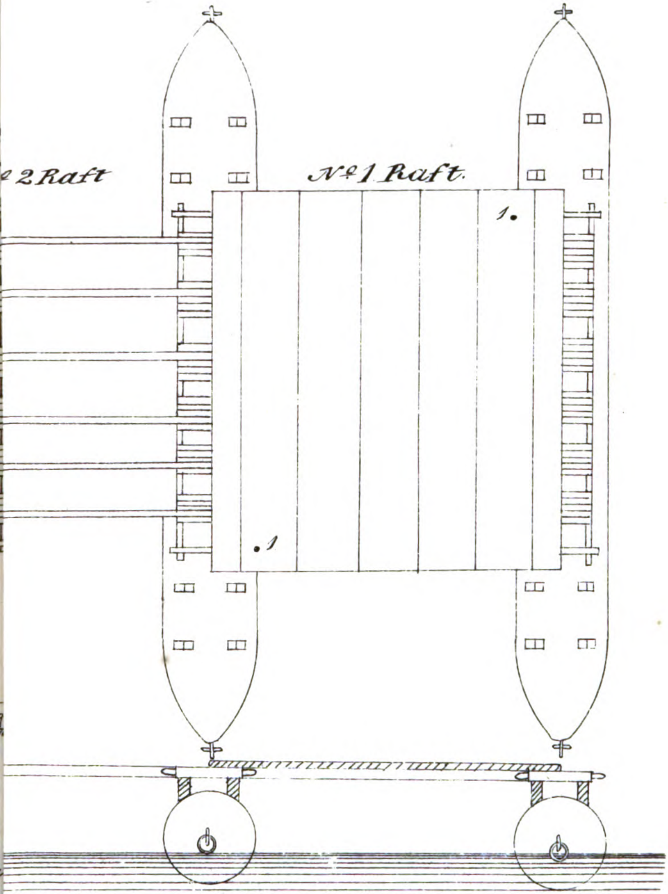
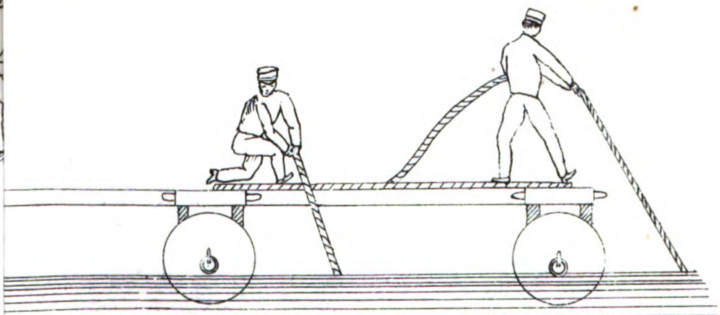
Plate 20

Section





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J. BINNY. LITH^R

BOOMING OUT.

The Pontoons should not be rolled down, but carefully carried to the edge of the water, below the position where it is intended to form the Bridge, and they will be brought up to their places against the current.

THE DUTIES OF RAFT DETACHMENTS.

RAFT No. 1.—Nos. 1 Cable men, who will keep the Bridge in its proper position, and belay the Cables to the Rafts by the belaying cleats of the Saddles of the Pontoons opposite to the Anchors, shifting them as the Bridge is boomed out, and taking great care that they do not cross the Cables.

* Nos. 2, SMALL STORE MEN, who take in four Oars and one Outrigger, on the starboard side of the Bridge, and three Oars, a Boat hook, and another Outrigger on the port side of the Bridge; which Stores are handed to them by Nos. 3 of No. 7 Raft. The whole of these Stores are laid across the Pontoons.

Nos. 3, LAY THE CHESSES, taking care that the joint of the two half Chesses are over the centre of the Saddles, and flush with the belaying Cleats.

RAFT No. 2.—Nos. 1 will lash the Saddles on the Pontoons, which must be over the centre and within three inches of the second handles from the ends of the Pontoons; this lashing must pass three turns over the Saddle and twice in front close to the ends of the Saddle, and be made fast by a couple of half hitches.

Nos. 2 WILL PASS THE PONTOONS, under the Saddles and Nos. 3 will haul them up to be in readiness.

RAFT No. 3.—FRONT SADDLE MEN.—Nos. 1 and Nos. 2 will pass and pack the Chesses on the Pontoon last inserted;

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* When Boots can be obtained they should be put on by the whole of the men of No. 2 Raft, and Nos. 1 and 2 of No. 3 Raft.

Nos. 3 pin the Baulks to the second Saddle from the land, assisted by the Baulk men.

RAFT No. 4.—BAULK MEN.—No. 1 starboard brings up the right Baulk, No. 2 next Baulk, No. 3 right centre Baulk, No. 1 port the left Baulk, No. 2 the next, No. 3 the left centre Baulk, and the whole will assist in pinning the Baulks to the Saddles, taking care to pin the 2 outside Baulks to the Saddles before any more are placed.

RAFTS Nos. 5 and 6.—CHESS MEN.— Nos. 1 of No. 5 Raft will bring up two half Chesses and lay them across the Baulks joining the shore bay, Nos. 2 the first whole Chess, Nos. 3 the second, Nos. 1 of No. 6 Raft the third, Nos. 2 the fourth, and Nos. 3 the fifth, which must be brought in succession, and be laid in a similar manner to the two half Chesses, with the wide space between the Cleats towards the River. The Chesses must be laid gently on the Baulks.

RAFT No. 7.—Nos. 1 and 2 SADDLE MEN.—Nos. 1 will bring up the front Saddle, and will lay it parallel to the River, with the pins towards the land; Nos. 2 will place the second Saddle at about 12 feet distance, and in rear of the former and paralled to it, with the pins towards the River, and so on alternately. These men will assist in pinning the Baulks to the rear Saddle.

Nos. 3 BRING UP THE OARS, Boat hook and Outriggers, and hand them to Nos. 2 of No. 1 Raft; taking care to hand four Oars and one Outrigger to the starboard side, and the remainder of the Stores to the port side of the Bridge.

Prepare to boom out.

No. 3 Raft will man the front Saddle, No. 4 Raft the centre Saddle, and No. 7 Raft the rear Saddle. Nos. 1 and 2 of each Raft will man the ends of their respective Saddle.

No. 3 the centre between the two outside Baulks, the port on the port side, and the starboard on the starboard side of the Bridge.

Prepare to lift. The whole of the Crews of Rafts Nos. 3, 4, and 7, will stoop down and lay hold of the Saddle and Baulks, and at the word "*Lift*," the whole of the superstructure will be raised up.

Boom out. The Bridge is pushed gently out, until the Pontoon to be inserted is in its proper position under the Saddle.

The superstructure is laid gently on the ground and the requisite stores for another Bay brought up, and so on until the length of Bridge is completed.

The men then go on Shore and Nos. 2 provide themselves with four Rack-Sticks and Lashings, Nos. 3 with a Breast-line each, and the Non-Commissioned Officer with two Grummets each, and they then fall in by Rafts in column parallel to the bank of the River, No. 1 Raft being in front. They are then marched in file to the Bridge and when on the Bridge they are not to keep Step.

Form by Detachments on your respective Rafts. Right face, Left Wheel. Quick March. Nos. 1 will halt over the Pontoon of their respective Rafts furthest from the shore; Nos. 3 over that nearest to the shore, and Nos. 2 in the centre of their respective Rafts; the Non-Commissioned Officers taking post in the centre of the Bays on the lower side of the Bridge; Nos. 3 immediately make their Breastlines fast to the handle of the Pontoon of their Rafts nearest the shore, and throw the end towards the shore to Nos. 1 of the next Raft who will make them fast to the Pontoon of their own Raft nearest the head of the Bridge. Nos. 2 Port will reeve the Rack-Sticks and Lashings through the inner handles of the Pontoon of their own Raft nearest the head of the Bridge; No. 2 starboard through the handle of the Pontoon nearest the shore. At the word "*Rack down*," each No. will provide himself with a Rack-Stick and Lashing, Nos. 2

handing two to each Non-Commissioned Officer. Nos. 1 and 3 place the Oars and Outriggers in their proper position, the middle row-lock of the Outrigger being over the belaying cleat of the Saddle of the portion of its Raft nearest the shore. The Oars and Boat-hook of each Raft being passed to the shore side of their Outrigger to form a junction between it and the next Outrigger to it, except in No. 1 Raft, half of the small stores of which are placed and racked down on either side of the Outrigger. Nos. 1 and 3 rack down over the Pontoons, No. 2 over the centre of the Raft and the Non-Commissioned Officers on both sides of the Bridge over the centre of the Bay. The Oars are placed, two blades towards the head of the Bridge, and two towards the shore, the looms resting on each other to bring them as close together as possible. The ends of the Oars and Outriggers will lap over each other in the centres of the Rafts and Bays, and will be firmly secured by a Rack Lashing.

When the Racking down is completed, each man sits down in his proper place, with his legs over the side of the Bridge.

RULES FOR BREAKING UP THE BRIDGE INTO RAFTS AND GETTING UNDER WEIGH BY DIVISIONS OF RAFTS.

Attention At this word of command the whole of the men stand up and face the head of the Bridge.

Prepare to Dismantle and form Every man of each Raft removes the Rack-lashings and Stick that he had made fast, and he hands them to Nos. 2 who reeve them through *divisions against (or with) the current— Dismantle.* the handles of the Pontoons, as before. Nos. 1 and 3 will turn over the half Chesses on the two outside whole Chesses of their own Raft; Nos. 3 then go to the extremity of the Bay next the Shore and turn up the Chesses and hand them to Nos. 2, who carry them to Nos. 1, who will lay the first three Chesses on the three whole Chesses of the Raft, cleats upwards, and the remaining two on the outside Chesses of these three first placed, cleats upwards. The men now get into their places on the Raft; if the stream is on the starboard side, the starboard side will face to the right about and the whole wheel to the right, halt over the Pontoons, and face outwards. If the stream is on the port side, the port side face to the right about and the whole wheel to the left, halt over the Pontoons, and face outwards. Nos. 1 and 3 will unpin the four centre Baulks. Nos. 1 and 3, starboard, will place the first three Baulks on the furthest whole Chess, and the single Baulk on the nearest whole Chess. Nos. 2 will take in the Oars, Outriggers, and Rack Lashings and will lay them on the half Chesses on their own side; blades of the Oars to the head of the Raft.

N. B. The Head of a Raft, when formed in a Bridge, is the end next the stream.

Unpin. Nos. 1 and 3 will unpin the outside Baulks, Nos. 3 must unpin the lower Baulk first, and No. 1 Stream Baulk last, and will lay them with the single Baulk. The Outriggers will now be laid on the Baulks over the Saddles, and racked down by Nos. 1, 2 and 3 of both sides. The Non-commissioned Officer will fasten his Grummet on the stern of the Raft during this operation. As soon as this is done, Nos. 2 will sit down in their proper places and man their Oars.

Cast off the Breast lines, and prepare to weigh your lower Anchor

The Breast-lines are cast off, on to the Raft they were first made fast to; in the mooring division they are coiled and laid on the ends of the Pontoons; in the reserve division they are taken on board and coiled ready to be thrown to either side. The Rafts of even number, or reserve division, must drop down with the current until they pass the lower line of Anchors of the mooring division. No. 1, starboard, and No. 3, port, of the mooring division will bend their Cables together

Weigh your lower Anchor

Nos. 3 warp on the lower Cable, and Nos. 1 veer out gently; when the Raft is hauled home to the Anchor it is to be weighed by No. 3 port, who will commence the coil of the cable, Nos. 1 immediately hauling in the stream Cable, and No. 3 Starboard, will haul in the Buoy, and Buoy line and coil it; when the bend of the two cables comes on the Rafts a new coil must be commenced with the head Cable, without unbending it. Nos. 3 then capsize the coil of the first Cable and place the Anchor, Buoy and Buoy line upon it and man their oars; Nos. 1 will continue hauling on the stream Cable: and on reaching the stream Anchor, will wait for the directions of the Commanding Officer, who must see that all the Rafts are ready before he gives the next word of command.

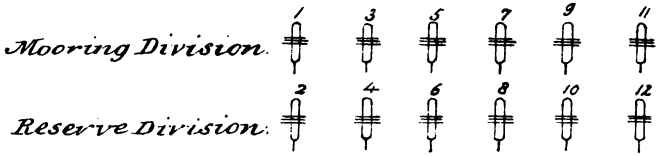
Weigh your stream Anchor, and form division against (or with) the current.

No. 1 Starboard will weigh the Anchor, No. 1 port will haul the Buoy line and Buoy on board and place them with the Anchor over the coil of the Cable. No. 1 will then take their Oars.

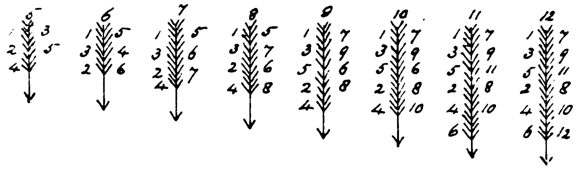
FORMING BRIDGE FROM RAFTS.

When the Bridge is about to be made, the Rafts must invariably be formed into divisions, with the mooring division in one line, always above, and the reserve division in a second line always below, in reference to the current or tide.

The following is the order of a portion of a Bridge of twelve Rafts when formed in divisions:—



The formation of column, with a varying number of Rafts, is as follows:—



When the whole number of Rafts is unequal, the extra Raft must be on the same side with No. 1, and the two leading Rafts must always be abreast of each other.

Prepare to cast the Stern anchor. On this word being given and repeated, No. 3 of each Raft will lay in their Oars; the port man seizes the Anchor and holds it in the position for heaving. The starboard man seizes the Buoy and Buoy line.

The Non-Commissioned Officer's whole attention being given to keep his Raft in its proper position.

Heave. No. 3, port, of each Raft heaves the Anchor and No. 3, starboard, the Buoy and Buoy line into the river; they then veer out the cable without giving too much slack. Nos. 1 and 2 continue rowing to steady the raft.

[This operation is described for Anchoring when going with the current; when forming Bridge from divisions against current, the mooring division give way for a short distance beyond where they are to Anchor, reverse right (or left) about, and cast stern Anchor immediately; then give way and cast head Anchor as before. This is necessary in order to cast the stern Anchor first, for if the lower Anchor was first cast, it would be imposible against a strong current, to row the Raft up to the position for heaving the stream Anchor.]

Prepare to cast the Head Anchor. Nos. 1 will lay in their Oars. No. 1 starboard seizes the Anchor and No. 1 port the Buoy and Buoy line holding them ready to heave. Nos. 2 continue rowing when about one half of the second Cable is veered out.

Hold on. Nos. 3 cease veering out and hold on by their Cables. Nos. 2 rest on their Oars.

Heave. No. 1 starboard heaves the Anchor, and No. 1 port the Buoy and Buoy line into the river; Nos. 2 lay in Oars and assist generally; Nos. 3 then bring the Raft into its place warping on the stern Anchor which is now called the stream Anchor, the other being called the lower Anchor. Nos. 1 veer out their cable without giving it too much slack. The Anchor men will unbend and hold on their respective Cables, to haul their Rafts a little higher or lower as may be directed by the Officer Commanding. When the Rafts are in their proper position, the Anchor men will receive the word "*Belay*." No. 2 will unrack the Outriggers and will lay them and the Oars across the ends of the Pontoons.

Reserve division form Bridge.

The reserve division will now come up on the interval between the mooring division. Nos. 1 and 3 starboard or port as the case may be will look out, and be ready to throw and receive Breast line, from the Raft they have to connect with and make them fast to the inner handles of the Pontoons, taking care not to tie the Breast line too short. As soon as Nos. 2 (Reserve division) see that the Breast lines are properly secured they lay in Oars, unrack Outriggers and lay small stores across Pontoons.

Baulks.

Nos. 1 and 3 starboard or port will receive and haul Baulks to and from the Rafts they have to connect with taking care that the Stream Baulk must be pinned first, then the lower and four centre Baulks, (the Baulks of each Raft being fixed for the Bay on its shore side); when the whole of the Baulks are pinned, the men will take their places on the Bridge. Nos. 1 and 3 will lay the two half Chesses on the Baulks. Nos. 1 will then turn up the whole Chesses on the Raft and will hand them to No. 2, who will carry them to No. 3, who will lay them on the Bay, "Rack Down."

Table shewing distance of Cylinders from centre to centre when boomed out at Open, Intermediate, and Close orders; and bearing of Baulks, and the number of Chesses required for each order.

Orders.	Distance.		Bearing.		No. of Chesses.		Remarks.
	Feet	inches	Feet	inches	Whole Chesses	Half Chesses	
Open........	12	6	11	4	5	2	For Infantry, Cavalry and Field Artillery.
Intermediate	10	5	9	3	4	2	
Close........	8	2	7	0	4	0	Heavy Artillery,

N. B.---When the Bridge is boomed out at close order it connot be broken up into Rafts.

TABLE.

Of the Weight of water-displaced by the Cylindrical Pontoons, for evey Inch of Immersion.

Depth sunk	Weight of Water Displaced.	Depth sunk	Weight of Water Displaced.
Inches	lbs.	Inches	lbs.
1	64·5	17	3982·0
2	182·6	18	4275·1
3	334·8	19	4571·6
4	513.6	20	4861·3
5	714·1	21	5145·7
6	933·2	22	5423·4
7	1168·0	23	5693·0
8	1416·3	24	5932·8
9	1676·1	25	6201·1
10	1945·7	26	6435·9
11	2223·5	27	6655·0
12	2507·9	28	6855·6
13	2797·5	29	7034·4
14	3091·1	30	7186·4
15	3387·2	31	7304·7
16	3684·6	32	7369·2

INFANTRY PONTOON EXERCISE.

The men to fall in two deep and number by twos; the front rank port, the rear rank starboard.

Prepare to form Bridge Saddles. Nos. 1 and 2 starboard bring up a Saddle each and lay them on the ground parallel to each other at the distance of 4′6,″ with the pins inwards. Nos. 1 and 2 port bring up two Lashings, each passing one to Nos. 1 and 2 starboard; the Lashings to be laid on the ground between the Saddles with the eye of the Lashings towards the left and in line with the Belaying Cleats of the Saddles.

Pontoons. Nos. 1 and 2 bring up a Pontoon and lay it on the Lashings equal distance from each end.

Saddles. The Saddles are then placed on Pontoons by Nos. 1 and 2.

Lash. Each No. will Lash the Saddles on his own side on the Pontoon, by passing the Lashing over the Saddles through the eye of the Lashing twice and make fast by two half hitches.

Baulks. Each number bring up 3 Baulks. No. 1 will pin the Baulks to the Saddle of their respective Rafts taking care that the outside Baulks are pinned to the outer Cleats of the Saddles. No. 2 will place and pin the Baulks of their respective Bays. The whole of the Baulks to be pinned from the centre or named Pontoon.

Chesses. No. 1 port will lay the Chesses on the Raft assisted by No. 1 starboard. No. 2 starboard will lay the Chesses on the Bays asisted by No. 2 port, taking care that the wide part of the Cleats are towards the head of the Bridge. The Bridge being now ready to be carried into the water, each No. will provide themselves with a Rack Stick and Lashing, passing the Rackstick through the Ring at the end of the Pontoon.

To move the Bridge down a Scarp or steep bank, turn the Chesses over the Saddles back on the next Chess. The Chesses must be lashed to prevent them from sliding forward. The Lashing to be made fast to the Baulk in front and brought over the Chesses and made fast to the same Baulk in rear.

Prepare to lift. Each No. with stoop down and take hold of the Rackstick. It would be much better to have additional men to carry the Bridge into the water.

Lift. Quick March. The whole moving towards the stream and launching the Bridge; should there be a current it will be necessary to have Anchors on the stream side of the Bridge.

The men now fall in on shore.

Small Stores. Nos. 1 will provide themselves with two Paddles and one side-piece; each No. 2 with a Breast line and two Rack-Sticks and Lashing, and one side piece each.

Quick March. Nos. 1 will halt over the further Cylinders from the land and will lay the Baulk and Paddles on the ends of the Cylinder.

No. 1 starboard on the starboard side and No. 1 port on the port side.

Nos. 2 will halt over the Cylinder of their own Raft nearest the shore, will make fast their Breast-lines to the Cylinders and will throw the end to No. 1 of the Rafts and their rear.

Rack down. Nos. 1 will Rack down over the Cylinder furthest from the shore. Nos. 2 will rack over the Cylinder of their own Raft nearest the shore.

Dismantle Each man undoes what he preivously did.

Guy Ropes should be used in descending a scarp or very steep slope.

It is more convenient to break the Bridge up into Rafts when to be Dismantled instead of hauling it ashore, which cannot be easily done.

This Bridge can be broken up into Rafts, the Baulks and Chesses of the Bay to be taken on board the Rafts, and the Bridge can be reformed any where.

Rafts can be used as Boats to take out Anchors &c.

Table shewing the weight and dimensions of one Carriage load.

Detail.	No.	Dimensions.					Weight.			Remarks.
		Length.			Breadth.	Depth.				
		Cylinder.	Cone at end.	Extreme.			Cwt.	Qrs.	lbs.	
Pontoons........	5	11'.10"	1'3"½	14'.5"	1'.3½"	1'.3½"	5	2	8	
Baulks..........	30	..	..	6.4½	0.3	0.1½	1	1	23	
Chesses.........	20	..	..	8.0	1.4	0.1	4	2	20	
Saddles.........	5	..	..	8.4	0.9	0.1½	..	3	12	
Sidepieces......	10	..	..	10.0	0.3	0.1½	..	3	14	
Girths &c.,......	10	..	..	4.6	..	..	..	..	15	
Racksticks and lashings......	10	..	..	2.0	.1½"	.1½"	..	..	16	
Chess Lashing..	10	..	..	6.0	1"	Rope	..	..	5	
Anchors........	3	..	..	..	..	..	..	3	6	
Cables..........	3	..	..	42.0	1½"	Rope	..	..	18	
Buoy and Buoy line...........	3	..	..	42.0	1"	Rope	..	..	15	
Breastline......	5	..	..	42.0	1"	Rope	..	..	12½	
Carriage........	1	..	..	..	..	..	9	..	..	
Total Weight.	..	..	..	..	..	..	23	3	24½	

INSTRUCTIONS FOR ROWING.

The men are to practice this duty at first in the Cutters, and are always to be told off Port and Starboard, and numbered before they begin.

The Words of Command "*One,*" "*Two*" are to be used at the commencement. At the word "*One,*" the men will feather their Oars and hold them horizontally. At the word "*Two*" they are to dip. The Officers on duty will direct their chief attention, to see that the men bend their bodies well, so as to pull with proper vigour, and that they do not plunge their Oars too deep. No hurry is to be allowed; and the practice of telling off an Idler to handle the boat hook must never be permitted. The words of Command to be used in Rowing are

"*Toss your Oars*;" "*Shove off*;" "*Down*;" "*Give way*;" "*Ease your port Oars*;" "*Pull together*;" "*Back your port Oars*;" "*Pull together*;" "*Ease your starboard Oars*;" "*Pull together*;" "*Back your port Oars,*" *and* "*Give way of all*;" "*Back of all*;" "*Give way*;" "*Pull hard your port Oars*;" "*Pull together*;" "*Pull hard your starboard Oars*;" "*Pull together*;" "*Oars*;" "*Rowed*;" "*In Bow*;" "*Lay in your Oars*;" "*Hook on*;" "*Fend off.*"

The technical terms to be used in Rowing are as follows:

Parts of a boat.---"*The Head*;" "*The Stern*;" "*The Stem*;" "*the Keel*;" "*the Gunnels*;" "*the Bow*;" "*the Quarter*;" "*the Thwarts*;" "*the Row-locks*;" "*the Gunnel Pins*" or "*Thowels.*"

Of the Oars, one is called the "*Bow Oar;*" another the "*Stroke Oar.*"

The Boat has a "*Painter*" and a "*Rudder.*" The latter steers it, and is moved by the "*Helm*" or "*Tiller.*"

These may be "*shipped*" and "*unshipped*;" a boat should be "*trimmed.*" It may be "*anchored,*" "*moored,*" "*warped*" or "*towed.*"

When in motion it may have "*headway*" or "*sternway.*"

Relative positions in a boat.---"*Port*;" "*Starboard*;" "*Fore,*" or "*forward*;" "*Aft,*" or *abaft*;" "*Midships*;" "*Ahead*;" "*Astern*;" "*Abreast*;" the "*Weather side*;" the "*Leeside.*"

"To *Windward*" to "*Leeward.*"

Parts of an Anchor; The "*Stock*" the "*Shank*" the "*Flukes*" the "*Crown.*"

Page 485.

Plate 2)

Selections.

On the Ignition of Charges of Powder in Shells and in Ordnance.

Fig. 1.

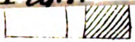


Fig. 2

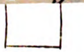


Fig. 6.

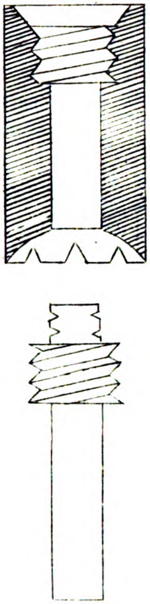


Fig. 7.

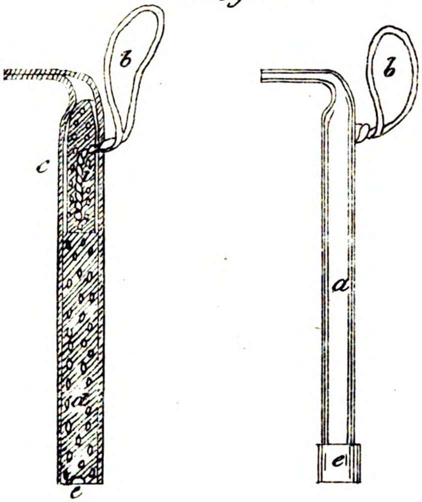
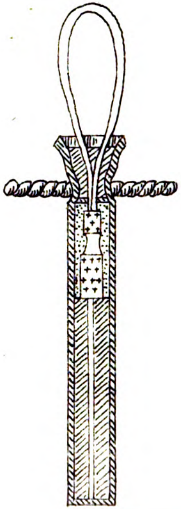


Fig. 8.



"Anchors" and "Grapnels" may be "*cast*" and "*weighed*," an Anchor may be "*apeak*" or "*foul.*"

In regard to a Cable or other rope, one may "*overhaul*" it; "*veer out*" or "*pay out*;" "*haul home*;" "*haul taught*;" "*reeve it*; "*belay the end*;" and "*coil up the slack.*"

A rope used in "*a tackle*" has "*a fall*" and a "*running part*" as well as a "*standing part.*"

Ropes may be used as "*Guys.*"

The above words of command and technical terms are to be read out, and explained to the men when they commence rowing. The Officers and Non-Commissioned Officers, in charge of this duty, will strictly adhere to them; and they are not to permit any improper terms to be used by the men without correcting them.

On the Ignition of Charges of powder in Shells and in Ordnance.

Since publishing the two articles in our numbers for the months of January and February last,* on the above subject, more information has reached us, which we now purpose laying before our readers. The chief source from which we shall draw is an admirable work on artillery, published at Carlsruhe in the early part of this year, entitled, "Handbook of the Science of Artillery, with more especial reference to the Matériel of the artillery of the Grand-Duchy of Baden,"† by A. Schuberg, captain in the artillery of the Grand-Duchy of Baden, a work which we beg to recommend in the strongest manner to the notice of our readers of that arm, as it not only gives all the details concerning the *matériel* in use in the author's own country, but enters into the latest improvements in most of the great artilleries of Europe. We shall not, however, confine ourself to this source alone, as in some instances the author is rather more terse than we could desire, but freely avail ourself of every other authority at hand.

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* Pages 393 and 411, Artillery Records head "Selections."

† Handbuch der Artillerie-wissenschaft, mit besondere Rücksicht auf das Materielle der Grossherzoglich Badischen Artillerie. Karlsruhe. 1856.

We find in a work on artillery* published in 1849, that experiments were then being made in France on a friction-fuze for hand-grenades. These experiments appear to have been of a satisfactory nature, for we find the fuze now regularly adopted in the service of that country. The apparatus consists of an ordinary fuze, having a small wooden tube, *a* (Fig. 1 Plate 21), fixed into the cup by means of the brass wires, *d d*, which encircle it. This tube contains the fulminating powder, into which is inserted a rubber, *b*, of flattened and serrated brass wire; the outer end of the latter is formed into a loop, to which is attached a noose of twine, *c*; the said noose is coiled away into the cup before capping the fuze.

To throw a hand-grenade provided with such a fuze, the grenadier wears a leather bracelet round his right arm, to which is attached a cord about a foot long. At the end of the cord is an iron hook, to which the noose is to be attached after uncapping the fuze. The grenade is thrown as usual, and on leaving the hand it naturally stretches the cord to its full length, and, continuing the movement, draws the rubber through the fulminating powder, whence results the explosion and inflammation of the fuze-composition of the grenade, which bursts after reaching the object.

The advantages of this system are self-evident. It requires no ordinary coolness, when close to an enemy—say at between 25 to 35 yards, the distance to which the usual hand-grenades may be thrown—to light the ordinary fuze, and hold the grenade in the hand while the fuze is burning during the time required to swing the arm backwards and forwards preparatory to throwing; for the thought that some imperfection in the fuze must inevitably cause the holder to be blown to atoms is far from a reassuring circumstance;

---

* Thiroux.

whereas, by means of the arrangement above described, the fuze is not lighted until the projectile has left the hand for its final destination. We humbly beg to draw attention to this simple but ingenious little invention, as the grenade is a missile which may be used to the greatest advantage in sieges at close quarters, in street fights, and in the defence of villages, when a small party of soldiers, under cover of a house or other building, have to defend themselves against numbers. The grenade provided with this new fuze becomes a safe projectile, which it hardly was under the old system.

Moorsom's percussion-shell, in use in the British navy, and Billette's, in the French, have never, we believe, been described in any publication. The construction of the former, however, is pretty well known among military and naval men, and, as we stated in our former article, it must be now equally familiar to the Russians. Of the latter fuze we have been unable to procure any description.

Percussion-shells are usually provided with a loading hole, to avoid the danger attendant upon setting home or extracting a fuze; those intended to be fired from long pieces are fastened into wooden bottoms. The different systems of ignition as used up to the present time are as follows:—

In one system the fuze-hole was provided with an iron fuze, somewhat similar in shape to a gun-bouche, having a nipple at the top to receive a percussion-cap. A second was upon Callerstrœm's principle, in which the fuze contained a drop of sulphuric acid enclosed in a thin glass tube, surrounded exteriorly with fulminating powder.

In the first system it was absolutely requisite that the shell should strike fuze foremost, a condition not always to be secured, in consequence of the rotation of spherical projectiles; it seems, however, to have been more certain when adapted to shells of an elongated form. Callerstrœm's fuzes, in which the sulphuric acid ignites the fulminating powder on the breaking of the glass tube, frequently do not withstand the powerful shock of the charge of the piece: the shell thus often bursts in the bore.

The following are the chief requisites of a percussion fuze:--the shell should not burst instantly upon striking, but after having penetrated the object; ricochet-firing is self-evidently impossible, but this should not apply to ricocheting over water. The effect of the heavy charges used in shell-guns should not have any disadvantageous influence on the projectile, nor should the shock caused thereby injure the percussion appparatus of the shell.

The percussion-fuzes invented by Douglas Tucker, an Englishman, and by Friedrichsen, a Norwegian Officer, seem to have given satisfactory results, but nothing further is publicly known concerning them. It follows, however, from experiment and practice, that so favourable a result cannot be anticipated from percussion-shells when of a spherical as when of an elongated and pointed form, because the point of the latter, to which the fuze is adapted, is always foremost; in consequence of which the percussion apparatus is better enabled to withstand the concussion of the charge of the piece.

Experiments have been lately carried on in Prussia, the Netherlands, and Belgium, with percussion shells which, when provided with the Belgian fuze, invented by Captain Splingard, gave very favourable results.

The Prussian percussion fuze, constructed on Callerstrœm's principle, consists of the fuze *a*, (Fig. 2 Plate 21) the percussion apparatus, and the column of composition. The first, which includes the whole arrangement, is screwed into the fuze hole flush with the surface of the shell, and is made of beech, acacia or alder wood, or of brass, and even of cast-iron. Its bore is divided into two cylindrical portions, having the same axis, the upper one having the greater diameter. The fuze is the same for every shell, with merely the slight difference, that in those intended for shells to be fired from pieces carrying small charges, the upper cylinder is somewhat longer. The percussion apparatus consists of a small glass tube, *b*, hermetically sealed at both ends, partly filled with concentrated sulphuric acid, and served round exteriorally with cotton thread, saturated with a composition of—70 parts by weight of chloride of potassa, 10 parts by weight of flowers of sulphur, 20 parts by weight of white sugar (pounded and sifted)—damped with spirits of wine. The coating of composition, *c*, is of such a thickness as to admit of the tubes fitting accurately into the paper case, *e*; the latter thus protects the former. The upper half of this coated tube fits into the leaden thimble *d*, while the lower accurately fills the lesser cylinder of the fuze. After affixing the percussion apparatus, the empty space *f*, left between the thimble and the sides of the greater hollow cylinder of the fuze, is driven with mealed powder; the drift for the purpose is hollow, having a bore somewhat larger than the diameter of the thimble. The rest of the fuze above the thimble is primed with mealed powder. Should there be reason to anticipate that the fuze composition would not be burned down before the shell strikes, 1½ per cent. of powdered charcoal should be added to the mealed powder.

As soon as the column of composition, which should be so arranged as to burn but for a very short time, is completely consumed, and the shell strikes, the leaden thimble falls out of the fuze from the shock against the object, and breaks the glass tube, whereby the inflammation is speedily communicated to the charge.

The percussion-fuze proposed by Captain Schönstedt, of the Dutch service, differs from the above-described chiefly in that it can be equally well employed as an ordinary fuze, and that it contains neither fulminate nor sulphuric acid. The fuze, *a*, (Fig. 3 Plate 21) composed of an alloy of equal parts of lead and tin, is similarly screwed into the fuze hole; it has a cylindrical bore, the upper half of which is larger than the lower, and likewise a second smaller channel, running parallel to the lower half of the central bore. This channel communicates with the centre bore towards the bottom of the latter. The thimble, *d*, corresponds to that above described. The glass tube, *c*, open at both ends, is thickly served, to keep it fast in the thimble and in the smaller bore of the fuze, the three parts being thus firmly connected. The side channel, *b*, is driven with the ordinary fuze composition, the vacant space, *e*, between the thimble and the side of the fuze bore, is likewise driven with a composition burning two seconds (two-thirds fuze composition and one-third sporting powder), while the glass tube is filled with rifle powder and a strand of quickmatch.

The percussion-fuze invented by Captain Splingard, of the Belgian artillery, remarkable for its simplicity, safety in transport, facility in employment, efficiency, and cheapness, is composed of a fuze, B, (Fig. 4 Plate 21) and a fuze-cover, A. The case, *a*, of the fuze is made of stout paper, rendered uninflammable by immersion in a solution of sulphate of ammonia; as an improvement the inside of the case has been lined with sheet brass. The composition is driven over a conical spindle in thin layers; both the drifts used, the one being hollow and the other solid, are tipped with copper. The lower portion *b*, extending just above the spindle, is a slow-burning composition; the next, *c*, burns at a medium rate; above this a portion, *d*, intended to burn quickly, is driven with mealed powder. After driving, the interior surface left by the spindle is coated once or twice with a varnish of shell-lac; when dry, liquid gypsum, or plaster of Paris, is poured in, and before it has solidified a spindle is introduced, which is directed by a guiding socket, thus leaving, when the spindle is withdrawn, a vacant space, *f*, open below, and running up the axis as far as *e*. As gypsum, when mixed with water, increases in volume, cracks need not be feared; at any rate they would be between the composition and the gypsum tube. The portion of slow-burning composition, which is driven solid above the gypsum, should be only a few twentieths of an inch in height, so that the gypsum tube, after the composition has burned for a few moments, may be sufficiently isolated: the fuze may thus be used for long or short distances.

When the upper end of the gypsum tube, *e*, which becomes gradually isolated, is broken by the shock which the shell sustains on penetrating the object, the inflamed gases rush through the hollow, *f*, in the middle of the tube, into the interior of the shell, and thus determine its explosion.

The fuzes thus prepared are primed at the upper end with mealed powder, spirits of wine, and quick-match; they are then capped with a disk of paper, and a second of linen; they are finally varnished exteriorly.

The fuze cover, A, which is to receive the fuze, is a truncated wooden cone, of the usual form of an ordinary fuze, having a bore symmetrical with the axis, divided into three parts. The upper and widest part, *h*, is fitted with a cork-ring, *i*, to hold the fuze; the diameter of the ring is a trifle smaller than that of the fuze, whereby the latter fits tightly into the former, but does not come in contact with it elsewhere: thus the concussions and shocks which the shell experiences in the bore have no injurious effect on the fuze. The middle part of the bore of the fuze cover is of a rather larger diameter than the fuze itself; the lower short part, *l*, serves the double purpose of a channel of communication for the gases from the fuze into the interior of the shell, and of a support to the bottom of the fuze. To hinder the bursting powder in the shell from getting into the interior of the fuze-cover, the bottom of the latter has a disk of thin cotton cloth glued to it. The fuze-cover is previously set into the shell; the fuze being affixed at the moment it is about to be used by a slight pressure of the hand.

In firing shells from mortars, the head of the fuze-cover may project beyond the exterior surface of the shell; but when firing from long guns, and especially from those of large calibre, such a circumstance would be injurious in consequence of the rotation of the projectile in the piece. It is, therefore, advisable to fix the shells firmly into sabôts to prevent this rotation as much as possible. The orifice of the fuze-cover, after it is set into the shell, can be closed with a wooden plug; so that there is no further laboratory work necessary either on boardship or in magazines, thanks to the nature of Splingard's principle.

It is evident that two sizes of fuzes, with their corresponding fuze-covers, will be necessary for shells of large and small calibres. During the course of experiments carried on in Sweden, this percussion fuze was still further simplified, the lining of the fuze with sheet-copper or brass, and the cork-stopper, being rendered unnecessary by rolling the cases by machinery.

The Sardinian artillery have adopted a shrapnel fuze, invented by Major Serra, and experimented on in 1846-47. It consists (Fig. 5 Plate 21) of a cylindrical fuze-case, *a*, of cast iron, which screws into the fuze-hole, the upper surface of its conical head, *b*, being sunk flush with the metal of the shell. Its lower end extends beyond the metal into the interior of the shell, and is hollowed out and serrated, as seen in the figure, so as to prepare it to receive its priming, thus ensuring inflammation. The fuze proper, made of bronze, is screwed into the fuze-case by means of a square tenon, *d*, just before putting the shell into the piece; the bore of the fuze-case is provisionally closed with an oakum stopper served with twine. The fuze is driven with mealed powder, and is of three lengths for each nature of shell, as follows :—

	12-pounder Gun.			5·9 inch Howitzer.		
	1	2	3	1	2	3
Time of burning in seconds.........	2	$2\frac{4}{5}$	$2\frac{3}{5}$	$2\frac{3}{5}$	$3\frac{3}{5}$	$4\frac{3}{5}$
Whole length of fuze in inches....	0·767	0·979	1·263	1·156	1·444	1·746
Do. composition column in inches	0·590	0·791	1·791	0·979	1·263	1·101

Selections.
Knots and Bends

Plate. 22

Fig: 1.

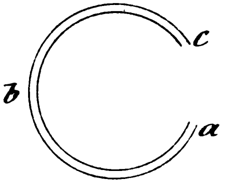
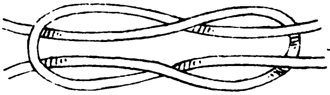


Fig: 2



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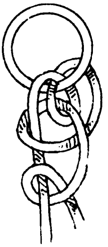

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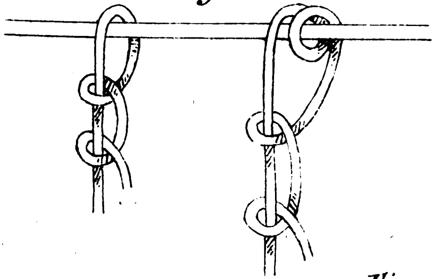

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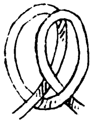


Fig: 7

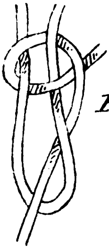
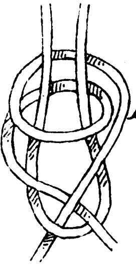


Fig: 8



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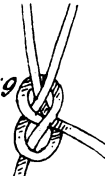

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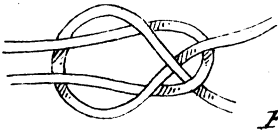

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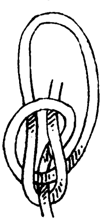
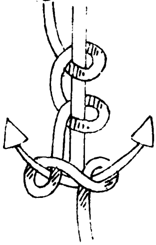


Fig: 11



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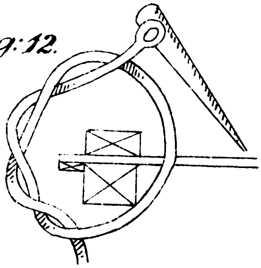

Fig: 1. Coiling a rope "with the Sun" commencing at a, an
continuing in the direction a, b, c.

Fig: 2. A Reef knot used for making fast the ends of lashings.

Figs: 3 & 4 } A Clove hitch used for making fast breastlines, pain
ers and ends of ropes.

Fig: 5. A Fisherman's bend used for fixing the Cables to th
Anchors, and the buoy-lines to the buoys.

Fig: 6. A Sheet bend used for connecting two Cables.

Fig: {7 8 9} A double Sheet bend also used for connecting two Cab

Fig: 10. A Bowling knot serves to throw over a post to haul

Fig: 11. The Buoy rope bend is used for fixing buoy lines to

Fig: 12. Method of Racking down the Chesses to the Baulk

The bursting charge of ordnance powder is contained in the interstices between the bullets. The shells have, provisionally, the same thickness of metal as the corresponding common shells.

A slight alteration has been proposed in the above described Serra's fuze—namely, that the fuze-case, made of an alloy of equal parts of tin, lead, and zinc, should be cast without a screw, but of a slightly conical form, so that it may be set home like an ordinary fuze. (*Vide* Fig. 6 Plate 21.)

With this fuze we shall leave the subject of "the ignition of charges of powder in shells," to return to it at a future period should any thing worthy of being communicated to our readers come to our cognizance. We shall now turn to the subject of "the ignition of charges of powder in ordnance."

Tubes, friction or percussion, are now all but universally adopted in the artilleries of Europe; the tube of the former description, in use in the Baden artillery, has been very highly recommended to the writer of this paper by an officer of the Prussian artillery, who was employed with his regiment in the campaign against that power in 1848-49. A considerable quantity of these tubes were taken, and afterwards experimented on by the Prussian artillery, and though they had been kept a considerable length of time they proved excellent. Indeed, this officer preferred them to those in use in his regiment, which we described fully in our former article; he declared the Prussian tube to be "like Moselle wine—it won't keep more than 7 years!" The Baden tube being thus recommended, we shall give its description *in extenso*.

The tube (Fig. 7 Plate 21) consists in an exterior tube, *a*, made of sheet-brass;* into the upper end of which, being slit for the purpose, is inserted an interior tube, *c*, of the same metal, which again is slit to receive the rubber; this rubber, *i*, served with cotton thread and smeared with fulminating powder, is made of tough hammered brass wire; the charge, *d*, is of musket powder, and its lower end is capped with writing paper: the whole tube is varnished and the upper end lacquered. The fulminating composition is ignited by a smart drawing of the rubber, which communicates the fire to the charge in the tube.

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* Sheet-brass appears very generally on the continent to be preferred to sheet-copper as a cheaper and equally good material.

The ingredients of this fulminating composition—4 parts of antimony, $\frac{1}{16}$ part of gum arabic, 4 parts of chlorate of potassa, $\frac{1}{2}$ part of charcoal, and $\frac{1}{2}$ part of sulphur—are separately pulverized, sifted through a hair sieve, and rubbed together for half an hour in a glass dish, omitting the chlorate of potassa; the mass is then damped with from 4 to 5 partsof distilled water; and finally the chlorate is added and rubbed into the mass by means of a glass spatula, until the composition forms a thoroughly mixed paste. The composition so prepared is spread out on paper and divided into small pieces after it is somewhat dried; it is kept in a granulated form, when perfectly dry, in a well-closed glass jar. The powder used for percussion-caps (without the chlorate) may replace the charcoal and sulphur in the above composition, because the ingredients are precisely the same, and have been incorporated in the stamping mill. The greatest precaution should be taken in the preparation of this composition, and every sort of friction, especially, should be avoided before the ingredients are sufficiently moistened; this is necessary in consequence of the crust which forms on the dish.

Both tubes are cut out of sheet-brass, then slit and formed into hollow cylinders; the smooth side of the sheet-brass being outermost; the larger tube is soldered outside.

To form the rubber the brass wire is bent double, forming a bight, and the ends twisted together; the twisted part is served with cotton thread to give the composition a better hold, the thread catching in the twists of the wire; it is then bent at right angles so as to form a hook, without, however, permitting it to make a sharp angle.

A thin paste being made of the prepared composition, the served portion of the rubber, called the hook, is smeared therewith. The rubber is inserted into the lesser tube, so that the top of the bend of the hook shall rest fast on the bottom of the split of the tube. The tube is then pinched together, thus fastening the rubber and closing the tube. The lesser tube thus prepared is again inserted into the greater tube, so that the rubber rests against the bottom of the split. The upper portion of the tube, being open as far as the slit, is pinched together as before and afterwards bent at right angles, the bight of the rubber being turned upwards so as to be parallel to the tube, without, however, making anywhere a sharp angle.

The musketry powder forming the charge is poured in and pressed tight from below, leaving a small hollow, *e*, at bottom; to close the tube, a star-formed piece of writing paper is pasted on the bottom, preventing the charge from being lost and the varnish from accumulating.

To preserve the tubes when dry frcm damp, and to prevent oxidation, and at the same time to close up any accidental orifice, they are varnished. The varnish is thus composed:—2 parts of gamboge, 2 parts of resin, 16 parts of fine shell-lac, 4 parts of oil of turpentine, and forty parts of spirits of wine. The upper end of the tube down to the bottom of the rubber is lacquered with varnish mixed with vermillion. The tubes are dried and varnished a second time. 1,000, with packing, weigh 12·4lbs, and cost, £2, 15s. 8d.

The tubes are proved by means of a weight representing the force requisite to ignition which amounts to about 25lbs.; they ought not to be injured by being shaken, and should detonate after being immersed in water for seven days. To ascertain the length and force of the flash a tube is inserted into the end of a piece of musket barrel placed vertically ; it should fire loose powder placed 3 feet below it.

One great advantage of the Baden friction-tube is the possibility of making them quickly without the aid of machinery ; the separate portions of the tube are kept ready made, and may be put together speedily, so that a large provision of prepared tubes is unnecessary.

The tube lately introduced into the Bavarian service is that invented by Grundherr, shown in (Fig. 8, Plate 21) and is of sheet-brass ; after the brass-wire rubber is introduced into the choked end it is driven with corned powder over a spindle ; the rubber is wedged in with a small piece of cork, and finally the top and bottom are closed with asphalte.

The former tube, experimented upon by Wepfer, waslikewise of brass soldered at the joint ; the rubber, smeared with the ignition composition, was enclosed in a writing-paper case, and protected by being served exteriorly with cotton thread. The charge of the tube was a double strand of quickmatch. To insure the rubbers completely closing the opening into the tube, it was served again exteriorly with waxed cotton thread. The upper end of the tube was pinched together, the lower was closed with a paper cross, and both varnished.

We have now, we think, placed before our readers almost all that is interesting and novel, as far as our information goes, on the above subjects, and shall take leave of them.*

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* United Service Magazine November 1856.

Selections.

Fig. 1

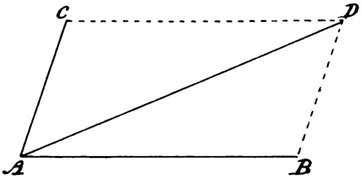


Fig. 2.

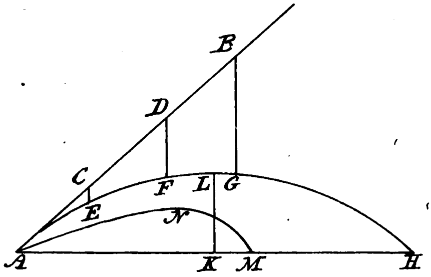


Fig. 3.

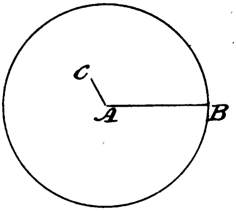
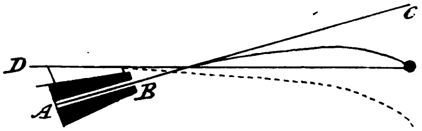


Fig. 4.



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Instructions in Musketry.

I.

It is desirable in commencing these Lectures to notice a few simple points which are generally well understood, and the comprehension of which aids the study of the passage of projectiles through the air.

Bodies.—A body is composed of numerous particles, which are separated by pores; the less porous a body is, or the greater the number of particles contained in a certain space, the greater is its density.

Specific gravity.—The density or specific gravity of a body is the proportion that its weight bears to an equal volume of water at a temperature of 39° 2′ F.

The specific gravities of the following substances are:—

Air	0·0912	Steel	7·81
Water	7·	Lead	11·85
Zinc	7·	Mercury	13·59
Iron	7·78		

Weight:—The weight of a body is its cubical contents multiplied by its specific gravity.

Vis Inertia.—The nature of matter is such that of itself it will not change its form or position; a body at rest would remain so, one in motion would continue to move in a straight line. This property is termed the *vis inertia* of matter, and the power which overcomes this tendency is a force.

Forces.—Forces producing motion may be divided into two classes: instantaneous forces, which act during an imperceptible period and produce uniform movement; and permanent forces, which act constantly either to increase or retard motion.

The elements of a force are the point of its application, the direction in which it urges that point, and its power.

The velocity.—The velocity of a body endowed with uniform motion is found by dividing the space it has passed through in a certain period by the time that it took to traverse the space. Thus the velocity of a body travelling 100 feet in 4 seconds, is 25 feet per second.

The velocity of a body moving with a regularly increasing speed is directly in proportion to the time of movement. So the velocity of a body when it had been one second in motion and the time of its movement, being known, their product will give the velocity acquired at the expiration of the given time.

The momentum.—The momentum or power of a moving body, is the product of its weight and velocity.

The resultant.—A body under the influence of two or more forces will move in the resultant of the forces, or, if the forces counterbalance one another, it will remain motionless. If two unequal forces are directly opposed to each other, the resultant will be in the direction of the most powerful.

The resultant of two forces not directly opposed to one another will be expressed by the diagonal of the parallelogram described upon the lines denoting the powers and directions of the forces. Thus *AD* (Fig. 1 Plate 23) denotes the power and direction of the resultant of the two forces, acting at the point *A*, represented by the lines *AB* and *AC.*

The centre of Gravity.—There is a point in every body through which passes the resultant of the forces of gravity that act upon each of its particles; this point is the centre of gravity. If suspended or rested at this point, the body will remain in equilibrium. The centre of gravity of a sphere is in a point equally distant from any portion of its surface. The centre of gravity of a cylinder is in the centre of its axis, and of a cone at a point in the axis one-fourth of the height from its base.

The fall of a Body.—The moment a body is freed from support, it is drawn downwards by the power of gravity, and it has been found that it will pass through a space of 16 feet in the first second, when it will have acquired a velocity of 32 feet; and the spaces traversed by the descending body are to one another as the squares of the times of descent; also the velocities are to each other as the times. Thus the descents and velocities at the expiration of each second are as follows :—

Times	1	2	3	4	5 seconds
Descents	16	64	144	256	400 Feet
Velocities	32	64	96	128	160 ,,

Atmospheric Resistance.—We will now consider the resistance of the air to the motion of a projectile. The atmospheric resistance is the result of the reaction of the force with which the projectile encounters the particles of air that it constantly meets in its course.

The degree of resistance experienced by a projectile will depend principally upon its density, its size, its form, and its velocity. Let us consider each of these points separately.

The Density.—The greater the density of a body, the more numerous are the particles that it contains to oppose to the atmospheric resistance; doubling the weight of a bullet, without any change in size or form, doubles its power of overcoming resistance ; and it will then only experience half the loss of velocity due for the resistance of the air before increasing the density. The losses of velocity are to one another, therfore, in an inverse proportion of the densities.

The Size.—Take two bodies equal in weight and similar in form, one of which exposes twice as much surface as the other to the atmospheric resistance ; it will encounter double the number of atmospheric particles that the lesser bodies does. We may, therefore, calculate the resistance to be in proportion to the extent of the surfaces on which the atmosphere acts ; this is however, not precisely true, as the air cannot escape so quickly from before the greater body, and, therefore, each of a greater number of atmospheric atoms will act for a longer period on the more extended surface than the fewer particles on the smaller space.

The form.—The adaptability of the form of the bullet to passing through the air chiefly depends upon the shape of the anterior portion; if it exposes a surface flat and perpendicular to the line of direction, the particles of air that it encounters will act directly against it with their whole force. Such would be the resistance experienced by the base of a cylinder moving in the line of the axis of the cylinder.

If the anterior surface of the figure is inclined to the line of direction, as in a cone moving point foremost, the atmospheric resistance acts obliquely, and expends some of its force in counterbalancing the pressure of the air, which is equal on opposite points; therefore only a portion of the atmospheric resistance is opposed to the movement of a bullet with a conical anterior termination.

Though the conical shape is better adapted to penetrate, it is inferior to a cylindrical form for a bullet, as, with equal heights and bases, the cone has only one third of the weight of the cylinder and therefore only one third of the power of overcoming the atmospheric resistance. In another respect the cone will appear inferior, on considering that a bullet separates particles of air that are not able to close immediately it passes them; consequently a vacuum more or less perfect, is formed behind the bullet. Now this vacuum leaves the posterior surface unsupported by atmospheric pressure, which would assist in nullifying the resistance in front. But the base of the conical being similar and equal to that of the cylindrical bullet, the same vacuum will be produced by either shape, while one description has so much greater power of overcoming atmospheric resistance.

These considerations suggest a combination of the two figures to produce the best form for a bullet—a cylinder with a conical termination to cut through the air.

A sphere possesses one advantage over all other shapes; whatever change takes place in its movement, it invariably exposes a similar and equal surface to the resistance of the air.

The velocity.—We have said that the resistance of the air to the movement of a bullet is the result of the reaction of the force with which it strikes the atmospheric atoms. If we double the velocity of the bullet, the force with which it meets the air is doubled. We may, then, for this cause, say, that doubling the velocity doubles the atmospheric resistance; and, considering that with doubled velocity the bullet will meet twice the quantity of air in the same period of time, we may calculate the resistance as again doubled, for this reason. Thus a fourfold atmospheric resistance results from doubling the velocity of a bullet. In a similar manner we might show that increasing the velocity three times produces nine times as great resistance. The atmospheric resistance is, then, as the squares of the velocities.

Heat and moisture will cause changes in the density of the atmosphere that scarcely require notice for such small projectiles as bullets; it is sufficient to observe that a rise in the thermometer and a fall in the barometer indicate a rarefaction of the atmosphere, that will decrease its power of resistance.

Now let us proceed to consider the course of a bullet. As soon as it leaves the barrel it is under the influence of three forces—the impetus bestowed upon it by the explosion of the powder, gravity, and atmospheric resistance.

Remove the power of gravity and the atmospheric resistance, and the bullet, under the influence of an instantaneous force, will move forward at a uniform rate in a straight line.

Let *AB* (Fig. 2 Plate 23) represent the direction, and *AC*, *CD*,*DB* equal distances through which the bullet would pass in the first, second, and third seconds after leaving the barrel.

In Vacuum.—Next let us imagine the musket discharged in vacuum. The bullet, driven in the direction *AB*, will, under the influence of gravity, lose 16 feet of ascent for the first second, 64 feet at the end of the next second, 144 feet at the end of the third second. From *C*,*D*, and *B* let fall perpendiculars; *CE* equal to 16 feet, *DF* to 64 feet, and *BG*, to 144 feet. *E*,*F*, and *G* are the positions of the bullet at the expiration of the first, second and third seconds of its flight in vacuum. Ascertaining more points would show that the bullet follows a curved line—*AEFGH.*

The Parabolic Curve.—This is termed a parabolic curve; its greatest elevation is in the centre of the curve, at the point *L.* The curve is the same on both sides of *L*, that is, the angles of ascent and descent are equal.

In Air. In the atmosphere the bullet will not describe such a curve. The constant action of the atmospheric resistance will gradually lessen the velocity until, towards the end of its flight, the bullet will move with much less velocity than at leaving the barrel; consequently the loss of ascent or fall due to gravity will be greater in proportion to distances traversed than it would be in vacuum, and the curve will be much greater towards the close of the flight, so that the bullet will fall the height that it has ascended while passing over a distance probably about half the distance that it passed over in its ascent. Let *ANM* represent the course of the bullet through the air, and *N* the highest point.

With an elevation of 45 degrees, a gun would throw furthest in vacuum: this is not the case in practice; some descriptions of cannon obtain their greatest range with an elevation of 42 degrees, and the rifle-musket at about 24 degrees elevation.

Centre of Gravity.—All bodies have a tendency to carry their centres of gravity, or heaviest end, foremost; this is equally the case with bullets. Let us take a spherical bullet, having the centre of gravity at *C*, (Fig. 3 Plate 23) at the distance *CA* from the centre of the figure. Suppose this bullet discharged from the barrel in the position shown in the diagram, and in a direction from *A* through *B* the resultant of the force of the resistance of the atmosphere to the bullet's movement will be in the line *BA*, and will act at the point *A* on *AC* as a lever to force *C* forward, until *AC* falls into the line of direction. If the centre of gravity *C* lies, at the time of discharge, directly behind *A*, the resultant of the forces of gravity passing through *C* will draw it downwards, and then the atmospheric resistance will act, as already explained, to bring to the front that portion of the surface of the bullet nearest to the centre of gravity.

The rotation of the bullet to change the position of the centre of gravity produces a change in the bullet's course. If at the discharge the centre of gravity lies above the centre of the figure, the rotation will cause the bullet to rise, and give an increase of range; for it is apparent that the resistance of the atmosphere to the rotatory motion will press the surface in a direction opposite to that of its revolution; in the case of the centre of gravity being above the centre of the figure, the posterior surface will move upwards and the anterior surface of the bullet downwards; if the pressure of the air were the same before and behind, no change of course would ensue; but the great pressure being in front, the bullet rises, that is in a direction contrary to the revolution of the surface in front. So also will the discharge of the bullet with the centre of gravity below, or on one side of the centre of the figure, cause loss of range or lateral deviations. The notice of these deviations is more curious than useful in considering so small projectiles as those used with muskets.

II.

We now proceed to notice some definitions pertaining to the gun and the course of the bullet.

The Barrel.—The interior of the barrel, or bore, of the musket is cylindrical, and of the same dimensions throughout; it is not so with the exterior, which is much larger at the breech where the powder explodes: here the metal requires sufficient thickness to resist the expansive force of the powder, which acts equally in every direction; in proportion to the distance from the breech, the force of the powder decreases; so may the solidity of the metal—it gradually diminishes until the least exterior diameter is attained at the muzzle. This construction decreases the weight of the musket and makes it balance easily in the hand.

The Axis.—An imaginary line, represented in the diagram by the line *AB*, (Fig. 4 Plate 23) is termed the axis of the barrel; it is supposed to pass through the centre of the bore, and is the course followed by the centre of the bullet while passing through the barrel.

The Line of Fire.—The line of fire, or line of projection, is the prolongation of the axis beyond the muzzle; it is represented by the line *BC* in the diagram; it is the line that the bullet would take if freed from the action of gravity and atmospheric resistance.

The Line of Sight.—The line of sight, or line of vision, is supposed to pass from the eye, through the centre of the notch of the back-sight, over the top of the foresight, and terminate in the object at which aim is taken. This line crosses the line of fire once. The position of the eye is shown at *D* in the diagram, and the line of sight is the straight line from *D* passing through the centre of the mark.

The Trajectory.—The curved line supposed to be described by the bullet in its flight is termed the trajectory; it is below the line of fire, and twice crosses the line of sight—once near the muzzle, and again at the mark.

The Plane of Fire.—The plane of fire contains the line of fire and the line of sight. The trajectory should also be in this plane.

The Angle of Fire.—The angle of fire is the angle contained between the line of fire and the plane of the horizon.

The Angle of Sight—The angle formed by the intersection of the line of sight and the line of fire is termed the angle of sight. It is equal to the angle of elevation given to the piece above the object at which it is aimed.

The Point-blank Range.—The point—blank range of a gun is the distance that it will throw, when fired, without any elevation, and at the height above the ground that it is intended to be generally used. Four feet six inches is about the average height above the ground that soldiers, standing, hold the barrels of their muskets in the firing position. The point blank range of a musket is, then, found by laying its axis in a horizontal plane, four feet six inches above the ground, and measuring the distance from the muzzle to the spot at which the bullet strikes on level ground when the gun is discharged in this position.

La Portée de But en Blanc.—It is necessary in French works to be aware that "la portée de but en blanc" differs from the point blank range; the former is the distance measured from the muzzle to the second intersection of the trajectory and the line of sight, when the aim is through the sight of least elevation.

The Initial Velocity.—The rate at which a bullet moves immediately it quits the barrel, is termed the initial velocity.

The Principle of sighting.—The principle upon which guns are sighted is, that the axis should be directed as much above the mark as the bullet would strike below the mark at the distance for which the sight is intended if no elevation were given to the musket. In the diagram, we observe that the aim is taken by the sights at the bull's-eye which the bullet is shewn to strike, while the line of fire passes over the target; the distance that the line of fire passes over the centre of the bull's-eye is eqnal to the distance that the bullet would have struck below the mark if the gun had been fired at the same range without any elevation; that is, with the axis and line of fire in the line now representing the line of sight. A dotted line represents the trajectory that would have been obtained without elevation. The greater the range the more elevation is required to be given to the muzzle; and rifles have moveable back sights, which are raised higher as the distance increases, so that the muzzle has to be raised to bring the fore-sight in a line with the back-sight and the mark.

To obtain a Trajectory.—We may determine the trajectory of a musket by firing shots from as many intermediate distances as may appear necessary. Each shot must be fired with the line of sight in the plane of the horizon, and with the sight set for the distance of which the trajectory is required, and the height above the mark that the bullet strikes the target at each distance must be noted; then, reducing the scale on paper, we can describe the trajectory by measuring along the line of sight the whole range and intermediate distances at which shots were fired; over each distance mark the altitude of the shot noted for that distance. The different points of the trajectory that are thus fixed may be connected by a curved line to denote the course of the bullet.

Another method is by fixing screens of cloth at intermediate distances along the range, and firing from the extremity of the range with a horizontal line of sight, and then measuring the height of each shot above the line of sight; if requisite, use the positions thus found to place the trajectory on paper as before. Either of these methods will only serve distances for which a target or screens of the necessary height can be obtained: and the use of the screens produces much inaccuracy, as the resistance experienced by the bullet in penetrating each screen must considerably reduce its flight.

We have considered the course of the trajectory to be determined by a single shot from each distance, but no satisfactory determination of the position of a point in a trajectory, or of the firing power of a weapon, could be obtained without firing several shots, and then taking the average effect of the whole number of shots fired. We will now proceed to consider the method of calculating this average value.

Vertical deviations.—To obtain the average of the distances that any number of shots strike the target above or below the level of the mark, draw a horizontal line passing through the centre of the bull's-eye; measure the distance at which each bullet strikes above or below the line, and note these measurements in two columns, one column for those over, and the other for those under the mark; total these two columns, and the mean vertical deviation is on the side of the line which has the largest total. Subtract the less total from the greater, and the division of the remainder by the number of shots fired will show the distance of the mean vertical deviation above or below the point of aim, according as the greater total indicated the mean deviation to be over or under the mark.

Let us take ten shots of which it is required to find the mean vertical deviation, and having measured their distances above or below the horizontal line, note them in two columns, as follows:—

Vertical Deviations.

UPPER.		LOWER.	
Hits.	Inches.	Hits.	Inches.
1	28	3	18
2	14	4	23
9	20	5	16
10	16	6	28
		7	25
		8	18
	Total...78		Total...128

Here we find that the average effect of the shots is below the line; and the difference, fifty inches, divided by ten, the number of shots, gives five inches as the mean vertical deviation below the mark.

Horizontal Deviations.—For ascertaining a trajectory, only vertical deviations are required; to test the accuracy of firing the mean horizontal deviation is also requisite. Divide the target by a perpendicular line passing through the centre of the mark. The lateral deviations are measured from this line, and noted in two columns according as they occur to the right or left of the line, and the calculation is similar to that for finding the mean vertical deviation.

The right of the target is that portion to the right of the person firing.

Let us suppose the lateral deviations of the shots already fired to be as follows:—

Horizontal Deviations.

LEFT.		RIGHT.	
Hits.	Inches.	Hits.	Inches.
1	15	4	14
2	14	6	25
3	8	8	18
5	13	9	24
7	11	10	20
Total	61	Total	101

These totals denote the mean deviation to be to the right of the mark, and if we divide their difference, 40 inches, by the number of shots, 10, we find that the mean horizontal deviation to the right of the point of aim is four inches.

Point of Mean Impact.—With these two deviations we can find on the target a spot representing the average relative position that ten hits have to the centre; this spot is termed the point of mean impact; its distance from the centre is the merit of the marksman. To find the point of mean impact for the above ten shots, measure along the perpendicular line the five inches mean vertical deviation above the centre of the mark, and on the horizontal line the four inches mean horizontal deviation to the right of the centre, at these points, four and five inches from the centre, raise perpendiculars to the lines on which the distances are measured; the intersection of these perpendiculars will be the point of mean impact. The distance of the point of mean impact from the centre may be obtained by actual measurement, or else, as the distance is a line subtending a right angled triangle of which the sides containing the right angle are 4 and 5 inches in length, we have only to square these numbers, add the squares, 16 and 25, and the square root of their sum, 41, will be about

6·40 inches, the distance of the point of mean impact from the centre.

The distance of the point of mean impact from the centre gives the merit of the shooting, not always that of the weapon, which may have been incorrectly sighted, and therefore, in the trial of a weapon, it is usual, after finding the point of mean impact of the shots fired from it, to calculate the average distance of the whole of the hits from their point of mean impact.

A String.—Perhaps the simplest plan for deciding in shooting matches is by the American method of "a string". In a fixed number of rounds the total of the distances from the centre of the bull's-eye of the hits of each person is a string; and, of course, the best shooting produces the shortest string.

III.

In this lecture are noticed the improvements that have so much increased the range and accuracy of fire from muskets, and thereby the efficiency of Infantry soldiers armed with rifle muskets, when they are trained to use their arms expertly.

Smooth Bores.—The great inaccuracy of firing from smooth-bored guns resulted from the pressure of the atmosphere upon any inequality on the surface of the bullet, constantly acting in the same direction, and thereby forcing the bullet from the true course.

The Rifle.—This defect is overcome by rifling, that is, cutting spiral grooves on the inner surface of the barrel. The lead should be jammed into these grooves, which should retain their hold on the bullet forced through the bore by the explosion of the powder; thus forced directly forward in the barrel, the grooves at the same time cause the bullet to revolve on its own axis in the direction of its course; and this rotatory motion, received in the barrel and continuing in the flight, prevents the deviations which the action of the air on surface irregularities has a tendency to produce. For if in any position the pressure of the air on an indentation or other unevenness in the surface of the bullet, has a tendency to drive the bullet in one direction, the rotatory motion will presently expose the indentation to a contrary action of the atmosphere, which will act in a directly opposite sense : thus any tendency to deviation caused by the pressure of the air on any spot will, in each revolution of the bullet on its own axis, be counteracted by an equal tendency to deviate in an opposite direction. Suppose a bullet to leave the barrel with an uneven surface on the right; the pressure of the air on this inequality in this position would tend to force the bullet to the left; but the rotation will place the inequality on the left, when the atmospheric pressure will have an equal tendency to drive the bullet to the right. It is then apparent that the rotatory motion exposes inequalities to contrary action of the atmosphere, and thereby neutralizes the tendency to deviation which would otherwise be produced.

Windage.—There still remained a defect common to the rifle and smooth bore to be overcome. To facilitate the loading it is necessary to have the bullet fit rather easily into the barrel; the difference between the diameters of the bullet and the bore is termed windage. The windage permitted a small portion of the gas generated by the explosion of the powder to escape between the bullet and the barrel: from this resulted not only a loss of force, but an increase of atmospheric resistance, from the escaped gas adding to the density of the air in front of the bullet in the barrel. Windage also produced great inaccuracy. Suppose, at the moment of discharging the gun, the bullet rested on the lower surface of the barrel, it would be driven forward by the force of the powder, while the portion of the gas escaping over the top would press it against the lower surface, whence it would bound to the upper surface, and so follow a zigzag course through the barrel; if the last touch was against the upper surface of the barrel, the bullet would fly low, experience a loss of range, and so probably strike the ground in front of the target. The last touch of the bullet being against the lower surface would, on the contrary, make the bullet rise; or lateral deviation from the intended direction might be produced by the bullet lying in the barrel close to either side.

In rifles this windage also rendered the bullets more liable to strip; that is, to escape from the barrel without taking the grooves.

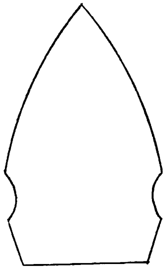
Many attempts were made to overcome these defects; breech-loading guns, with the diameter of the barrel at the breech rather enlarged, were suggested. They have not been introduced into the French or English service; it is only lately that the escape of a portion of the gas generated by the explosion of the powder has been prevented. The breech-loading rifle used in the Prussian service is not simple enough, and too liable to be deranged to serve as a musket.

Greased wads of leather or cloth were wrapped round bullets to make them fit the barrel tightly. Previously to 1853 the rifle regiments of our army used a two grooved rifle with a spherical bullet having a ring round it to fit the grooves. It did not load very easily, not did it give good shooting over 300 yards.

Carabine-à-tige.—In France the military rifle had much earlier reached a greater state of perfection. In 1846, Colonel Thouvenin produced the carabine-à-tige, which was given to select troops, sighted to 1,300 metres, about 1,455 yards, which distance the bullet traversed in less than eight seconds. The tige is a thin cylinder of steel rising perpendicularly from the centre of the bottom of the breech to support the bullet and prevent it from injuring the powder, while a few sharp blows from a heavy ramrod forces the lead to expand and fill the bore and grooves.

Cylindro-conical Bullet.—The bullet used with the carabine-à-tige was a cylinder with a conical head; its length was nearly twice its diameter. Much heavier than a spherical bullet for the same bore, it has consequently greater power of overcoming atmospheric resistance, while it only exposes the same extent of surface to the air; but, to preserve the superiority due to its shape, the cylindro-conical bullet must move so as to keep its axis a tangent to the trajectory; otherwise, instead of cutting through the air with the conical termination, it would expose its whole length to the atmospheric resistance.

At the close of Lecture I we noticed the tendency of the centre of gravity to go forward, and as the centre of gravity of the cylindro-conical bullet is nearer to the base than to the conical termination, we might conclude that the bullet would turn so as to throw the base to the front; but while in rapid motion the resistance of the air is so great that it resists the tendency of the bullet to turn, and therein oppose its largest surface, its length, directly and perpendicularly to the action of the air. Yet in the simple cylindro-conical shape there is a partial exposure of this surface, which was found to produce great inaccuracy in shooting; for the bullet first used with the Carabine-à-tige was not simply cylindro-conical: the diagram is the section of the original bullet that was used with this arm. The annular indentation near the base was merely intended to hold a greased wad. With an initial velocity of about 1,100 feet, it traversed a space of about 1,455 yards in rather less than eight seconds, invariably striking the mark point foremost, and, at this distance, piercing two and leaving an inpression on a third panel of poplar wood, each plank rather more than $\frac{3}{4}$ inch in thickness, and placed about 20



inches apart. Supposing that the groove near the base might in some degree impede the velocity, it was removed, and great decrease in accuracy of shooting was at once noticed.

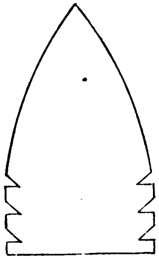
Derivation.—In observing the effect of this groove, a French Officer, Captain Tamisier, was led to discover the cause of a lateral deviation, which had previously been attributed to the wind; and, during numerous experiments at Vincennes, it was proved that, in firing from a rifle grooved from right to left, the point of mean impact was invariably to the left of the mark, and that a rifle grooved from left to right invariably threw to the right. This deviation he termed " derivation;" at a distance of 200 yards it averaged four inches, and at 900 yards it amounted to thirteen feet.

Derivation is caused by the rotation of the bullet on its axis, and is much increased when the bullet flies with its axis parallel to the line of fire, instead of keeping its axis a tangent to the trajectory. In the barrel grooved from left to right, the upper surface of the bullet receives a movement of rotation from left to right, while the lower surface revolves from right to left; and the resistance of the atmosphere to the rotation will drive the bullet in a direction contrary to the rotation of the surface acted upon by the air. Now, if the atmosphere pressed equally on all sides, the direction would not be changed; but with the axis of the bullet parallel to the line of fire, the lower surface is exposed to the pressure of the air from the front; and as the revolution of this surface is from right to left, the bullet will be forced to the right.

In a rifle grooved from right to left, the lower surface of the bullet receives the movement of rotation from left to right; and therefore, when this surface is exposed to greater atmospheric pressure, the bullet is driven to the left.

Perhaps we may illustrate this theory by explaining that " derivation," in musketry and " side" in billiards are similar deviations produced by the same cause. The bullet and billiard-ball both deviate in a direction contrary to the revolution of the surface meeting the greater resistance. With the billiard-ball, the greater resistance is experienced by the surface coming in contact with another ball, the cushion, or the cloth, as it may happen; while with a body moving so rapidly as a bullet, the greater pressure of the air on one surface is sufficient to engender deviation.

Cannelures.—Captain Tamisier, for the annular indentation at the base of the bullet, substituted three angular grooves, which, on the least deviation of the course of the bullet from the direction of its axis, expose surfaces directly opposed to the atmospheric resistance; and thus these grooves, termed cannelures, serve to increase the tendency that the pressure of the air on the cylindrical portion of the bullet has to cause the axis constantly to follow the curve of the trajectory. In shooting from the same rifles with bullets formed with these cannelures, derivation was hardly perceptible.



Minié Bullet.—A musket to be depended upon for long ranges had now been found; but there still remained defects in the difficulty of loading, the time required for loading, and the liability in hammering the bullet on the tige of so much deranging its shape as to produce inaccurate shooting. These defects were overcome by a discovery popularly attributed to Captain Minié. He used a simple rifle musket without the tige, and with a bullet similar in shape to that employed with the carabine-à-tige; only the new bullet has a hollow in the base: into this hollow an iron cup is placed. The explosion of the powder expands the base, so that the base and grooves are completely filled by the lead. By this simple plan all the defects of windage are overcome; the bullet is made sufficiently small to pass easily down the barrel, with the certainty that the powder will expand it so as to make it take the grooves and prevent any escape of the gas generated by the explosion of the powder. This method was tested in 1849 at the Ecole de Tir de Vincennes, and found to produce more accurate shooting than the carabine-à-tige; and the superiority of the minié bullet became more apparent at the longer distances.

At the suggestion of some other French officer, the minié bullet was tried without cannelures, and proved very inferior.

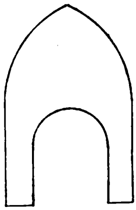
England at length awoke to the necessity of supplying her infantry with a better description of weapon than the old smooth-bore or even the two-grooved rifle. In 1850 a series of experiments was instituted to ascertain the most efficient description of musket. The result was the selection of the 1851, or more generally known as minié rifle. 28,000 of these rifles were ordered, and a school of musketry established at Hythe, under Colonel Hay, for the purpose of preparing officers and soldiers of different regiments to return to instruct their corps in the use of the new musket. To the late Lord Hardinge is due the credit of having placed an improved weapon in the hands of the English soldier; and, humanly speaking, the nation is indebted to him for the change of musket having been made sufficiently early to have been used in the war with Russia. We have already become so reconciled to the general use of rifles in the army, that it is almost impossible to recall to memory the opposition made to the innovation. The idea that soldiers generally could be trained to the use of a rifle was ridiculed. The old musket had admirers who regretted to part with it, notwithstanding every proof of the inferiority of its shooting.

In a trial at Hythe of the old musket against the 1851 rifle-musket, by twenty men firing ten rounds apiece from each description of weapon at each distance, at a target six feet high and twenty feet long, the rifle proved itself superior to the old musket by 20 per cent of hits at 100 yards, by 37½ per cent at 200 yards, by 39 per cent at 300 yards, and by 48 per cent at 400 yards.

The weight of the old musket, with bayonet, is about eleven pounds and a half, and of sixty rounds of ammunition about five pounds and a half; the musket, bayonet and ammunition together weighing about seventeen pounds.

1851 *Rifle.*—The 1851 rifle is nearly a pound lighter (weighing, with bayonet, 10 lbs. and 9 ozs.) than the old musket; but sixty rounds of ammunition for the rifle weigh 6 lbs and 12 ozs.; so the weight to be carried by the soldier was 17 lbs. and 5 ozs., an increase of 5 oz. with the new weapon. The other principal dimensions of this rifle are as follows:—Length with bayonet, 6 feet and half an inch; the length of the barrel 3 feet and 3 inches; the bore cylindrical, and ·702 inch in diameter, with 4 grooves, having a regular spiral of half a turn in the length of the barrel.

The bullet has a conoidal head, to which the head, of the ramrod is more readily adapted than to a cone in loading. The length is 1·02 inch, and diameter ·69 inch; and the depth of the hollow into which an iron cup fitted, ·5 inch; the weight, 680 grains. This bullet was used in a greased cartridge, with 2½ drams of powder. In repeated experiments at Hythe, up to 900 yards, the shooting was successful, the bullet striking the mark with the point.



Enfield Rifle.—The 1851 rifle was very soon superseded by an improved description, the 1853 or Enfield musket, which may without hesitation be declared to be the best weapon ever given to an army.

The weight of the Enfield rifle with bayonet is 9 lbs. 4 ozs., and of sixty rounds of ammunition 5 lbs. 3 ozs., making together 14 lbs. 7 ozs.; a decrease of nearly 3 lbs. in the weight for the soldier to carry. The length of the musket with the bayonet continues 6 feet 0½ inch, and of the barrel 3 feet 3 inches; the bore is ·577 inch and cylindrical, with three grooves, having a regular spiral of half a turn in the length of barrel. The bullet is similar to that used with the 1851 rifle; its weight 520 grains, and diameter ·568 inch. A wooden plug has been substituted for the iron cup as an auxiliary of expansion, and is stated, in a report of experiments at the school of Musketry, to produce " more certain and uniform expansion" than the cup.

The following per-centage of hits with hundreds of rounds fired from the shoulder with the 1851 and 1853 muskets by detachments at Hythe, is taken from a report of experiments at the school of musketry :—

PER-CENTAGE OF HITS AT EACH DISTANCE.

Proportionately to distance, the targets 6 feet high, increased in width from 2 feet to 16 feet.

	100 yards	200 yards	300 yards	400 yards	500 yards	600 yards	700 yards	800 yards	900 yards
1851 Rifle	59·05	37·43	33·67	28·35	26·22	25·52	14·28	22·22	3·80
1853 Rifle	65·02	38·55	37·38	41·23	46·10	27·54	23·52	22·22	10·66

The point blank range of the Enfield Musket is 177 yards. It is sighted from 100 yards to 900 yards: for the latter distance the elevation is about three degrees, and the time of the flight of the bullet about three seconds.

IV.

We have now followed the principal changes in the musket from the smooth bore to the Enfield rifle, and may observe some of the chief points requiring notice in using the rifle.

Position.—The soldier cannot be too carefully instructed in the positions of firing, both standing and kneeling. His success at target practice very greatly depends upon his position in firing. It is almost incredible how great an improvement has been produced in soldiers' shooting by their having been well instructed in the best positions of firing.

Aiming.—It is necessary to be particular in ascertaining that the soldier understands how to aim correctly, by making him lay his musket on a rest, and observing whether he has placed it so as to exactly cover the mark. Snapping caps at the flame of a candle placed about three or four feet from the muzzle, is the best practice in aiming. The recruit should never be permitted to fire at the target without having been previously exercised with caps and powder; otherwise he will probably be so alarmed by his first shot, that he will close his eyes and jerk his body, and never recover the shock. He should also be instructed that pressing the piece against the shoulder prevents or decreases the recoil.

Sights.—Allowance must always be made for defects in the sighting. Some muskets have too much or not sufficient elevation given for the different distances; some throw to the right or left.

Much care should be taken to keep the sights upright, neither inclined to the right nor left; for loss of range and lateral deviation will be the consequence of any inclination.

If the sight is inclined to the right, the ball will strike to the right, and below the mark; and on the inclination being to the left, the bullet will go the left, below the mark.

Wind.—Wind will change the course of the bullet; if blowing from the right, it will drive the bullet to the left of the mark; consequently, allowance will have to be made by aiming to the right; and when the wind blows from the left, aim to the left of the object. Wind blowing from the front acts directly against the motion of the bullet, and requires additional elevation to be given to counteract its effect. So, if the wind blows in the direction of the bullet's course, it will be necessary to aim below the mark. No rule can be given for the amount of allowance to be made for wind; practice alone can teach how much to make, and the strength of the wind must be considered. It has been found necessary to aim as much as eleven feet to one side of the mark, to allow for the deviation caused by a moderate wind blowing across the course when shooting at a distance of five hundred yards. The more slowly the bullet moves, the longer will it be subject to the influence of the wind; and therefore the deviation caused by wind will be greater than in proportion to the increase of the range.

Heights.—In firing at elevated objects at an angle of 45 degrees, or more, above the plane of the horizon, the bullet will have to move in a direction opposed to the attraction of gravity; and allowance will therefore have to be made by firing rather above the mark. On the contrary, in shooting at an object much below, reduce the elevation due for the distance, that is, aim under the mark.

In shooting at a moving body, allowance will have to be made according to the rapidity of movement, aiming high or low, to the right or to the left, as the object retires or advances, moves to the right or to the left.

Ammunition for muskets is usually kept in parcels of ten rounds each. After firing a few rounds, the remaining cartridges left loose in the pouch would be very liable to injury by being shaken, therefore any loose cartridges should always be tied together; and, if possible, this should always be done before moving even the shortest distance from the field or practice-ground.

In target practice, carefully instruct the soldier to dwell on the aim if his musket misses fire, and then to come to the "recover."

Every precaution must be taken to keep damp from the charge; a little grease or a splinter of wood in the nipple will prevent moisture from penetrating, while it will not hinder the cap from acting to ignite the charge. In loading during rain, great care must be taken to cover the barrel. At all times, when not shooting, stoppers should be in the muzzles to keep dust as well as moisture from entering.

In advancing to a surprise or night attack, muskets should not be capped until the last moment; otherwise an awkward or cowardly individual may most easily derange the best plan. For the same reason, arms should be "ordered" by a party in ambush, and no one allowed to put his hand near a trigger; the supernumerary rank should be most observant, to prevent any one from moving a musket until the order is given. The necessity of knowing the distance of the object, in order to give the proper elevation, requires soldiers to be trained to judge distances; and this is done by instructing them to notice the changes in appearance of men stationed at intervals of fifty yards. Afterwards, the ability of correctly judging distances is tried by placing men at unknown distances which the soldier is required to value, and his opinion is corrected by measurement. If cavalry are stationed near infantry, the latter should be habituated to judge distances of horses and men.

In practice it is preferable to underrate a distance, as the bullet will probably ricochet into the object; and the spot where the bullet strikes the ground is often marked by some substance being thrown up; and thus a guide to the proper elevation of the next shot is obtained.

In using the 1853 musket against large bodies at distances over 500 yards, a little too much elevation is not of much consequence, as the bullet passing over the front rank of the column will drop into the ranks in rear.

Regimental Officers should be well acquainted with the distance that each of their men can fire with effect, and, on service, should prevent indifferent shots from wasting ammunition by firing at longer ranges than they have been practised in firing.

Random firing is not only throwing away ammunition, but encouraging the enemy, whose spirit is raised by finding that the fire of their opponents is so ineffectual. At the same time, men firing without producing any marked effect upon the party opposed to them become discouraged, and imagine that fortune is against themselves.

Men should be instructed to select some particular mark to aim at; in short ranges an individual, and in longer ranges a gun or point in a column. Though it requires courage and coolness to do this while under fire, still the endeavour to persuade men to aim at certain objects tends in some degree to prevent wild shooting.

The best shots may be employed very advantageously to act against artillery at distances exceeding 900 yards; probably as far as 1,200 yards the Enfield musket would answer well against so large a mark, while the riflemen would separate and easily find sufficient cover. A shell for the musket, to be charged with powder and explode on striking a body, will probably be introduced into the service in the course of time to employ generally in causing the explosion of ammunition cases.

Riflemen employed to subdue the fire of a fortress should be placed in favorable positions, affording good cover, either natural or artificial; they should keep their rifles constantly in position to fire on the least exposure of the enemy, yet every shot should be precisely aimed at some certain object. A steady fire from men selected for their good and certain shooting will very considerably reduce the fire from the place. A small number of rounds used in this manner will produce much greater effect than a hundred times the number of shots fired at random.

Soldiers must be well instructed that upon their own steadiness depends their power of resisting cavalry. A single company (well disciplined and well led) of English Soldiers might defy the cavalry of the world; and certainly a well-trained regiment may receive cavalry charges with the most perfect confidence, though it would hardly be prudent to expose a regiment in line willingly to a charge, as the greater the front the more possible it is to force the horses against the living deathful obstacle. The greater the confidence of the men, the more destructive to the cavalry will be their resistance. No cavalry could be expected to come to the charge exposed over a space of 1,000 yards to the fire of Enfield muskets used with cool steadiness, such as may be expected in a British regiment composed of soldiers the majority of whom had been once or twice in action.

We have followed all the changes in the musket from the smooth-bore to the Enfield rifle, and the latter is undoubtedly the best weapon that has ever been given to an army. Doubtless great improvements in firearms will render it advisable to substitute some other weapon for the musket in use at present; but changes so expensive should only be decided upon after cautions deliberation and investigation. We have already experienced the consequences of hasty decisions. The contractors had barely time to execute the order of 28,000 rifles of the 1851 pattern before the propriety of substituting the 1853 or Enfield musket was decided. The first description had to be withdrawn, as the same ammunition would not serve the Minié and Enfield rifles, and very serious inconvenience might arise on service from confusion of different ammunitions. Our aim should be to keep our army better armed than that of any other state; at the same time we should guard against hasty and inconsiderate determinations..

The reports of experiments are issued every year from the School of Musketry, and in the two already published, trials of the Enfield rifle against Austrian and Swiss rifles are given. The following are extracts from the reports of these trials:—" In construction and finish, in accuracy of shooting, penetration, and velocity, and as an *arme blanche*, the English rifle musket, 1853, is superior in every particular to the Austrian rifle, with long or short barrel; it is also lighter." Of the Swiss rifle the report says:—" The trial of this rifle, fired by one of the first shots in Switzerland against the rifle musket, 1853, commenced at 800 yards; only one of 32 shots fired from the Swiss rifle hit the eighteen-feet square target; the rifle 1853 was then fired at the same distance and target; every shot fired therefrom, viz., 21 in succession, hit the target. The trial did not proceed, as the Swiss rifle was said to be out of order; it was accordingly postponed for three days. Nothing, however, has been heard of this rifle since."

We can hardly turn from these reports of Colonel Hay without noticing an original description of rifle that occupies a conspicuous place in the reports: it is Mr. Lancaster's elliptical-bore musket. The bore is smooth, and the effect of rifling is obtained by a twist in the bore itself; the greatest diameter, at one part lying between the upper and lower surfaces, gradually turns until at another point the greatest width of bore is found between the two sides. The bullet is adapted to the bore. The shooting from this rifle appears to be very little inferior to that from the Enfield, except that there is said to be a great liability of the bullet fired from it to strip, that is to say, to be forced out without taking the twist. There is an advantage in this rifle, that the barrel does not require increased thickness to admit of grooving.

We learn also in these reports that the construction of breech-loading muskets has reached a very great degree of perfection, and as this description of gun is so much more rapidly loaded, it is probable that breech-loading will be adopted for muskets when any change is considered necessary.

Lastly, we must notice a trial at Hythe of the Whitworth rifle, that has been published in the daily papers.* The bore is smooth, and the rotatory movement is given to the bullet as in Mr. Lancaster's musket. The peculiarity of the new rifle is an hexagonal bore, with a twist of two turns in about 39 inches.

The following is the reported result of the trial of the Whitworth against the Enfield rifle; ten shots were fired from a rest with each arm at each distance.

	Range in yards.	Elevation in degrees.	Mean distance from centre of Hits. Feet.
Whitworth	500	1·15	0·37
Enfield		1·32	2·24
Whitworth	800	2·22	1·0
Enfield		2·45	4·11
Whitworth	1100	3·45	2·41
Enfield		4·12	8·04
Whitworth	1400	5·	4·62
Enfield		6·20 to 7	No hits.
Whitworth	1800	6.40	11·62

The reported results of the trial of the Whitworth and Enfield rifles for penetration are equally in favor of the former. The Whitworth rifle drove a bullet through 33 half-inch elm planks, while the bullet from the Enfield rifle stuck in the 13th plank.

In concluding these lectures, we may suggest that the use of cannelures would probably greatly increase the accuracy of shooting from the Enfield musket; and if, by experiment, it is found that the use of cannelures will permit an increase in the length of the bullet, greater range and less elevation would also be obtained.†

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* Vide Artillery Records "Miscellaneous" pages 622 to 627.

† Colburn's United Service Magazine July and August 1857.

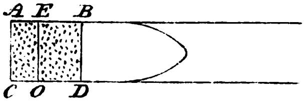
General Jacob's Rifle and the Progressive Combustion of Gunpowder.

To the Editor of the United Service Journal.

School of Musketry, Poona, 30th August 1857.

SIR,—Within the last week I accidentally came across a letter written by a Mr. Boucher to the *Field* newspaper, under the title of "Hints to Riflemen," and containing many interesting facts concerning General Jacob's rifle. After alluding cursorily to the shape of the ball and its altered state on being fired, he proceeds to lay down a golden rule for riflemen, which so few (he says) lay to heart, namely, that the quantity and quality of the powder, the weight and form of the bullet, and length and calibre of the barrel, should all be regulated in accordance with one another, but makes no mention of "rifling." It is more especially with regard to this subject that I wish to address you at the present moment, as to whether *increased range* is thereby obtained, and in what manner. In the "Instructions" laid down by the Horse Guards (p. 18) we find it stated that "the only object of rifling a barrel, is to correct by this means the flight of the bullet; it does not, *of itself*, produce either greater range or velocity. True, it does correct the flight of the bullet, and certainly does not, *of itself*, produce greater range or velocity; for "No machine," says Lardner, "can add to the mechanical energy of the power; being composed of inert matter, it cannot generate force, and consequently the working point cannot exert more force than is transmitted to it from the point of application of the power. It will, in fact, exert less, because friction and other sources of resistance must intercept a portion of the action of the power." Good; but a machine can economize that power so that it be applied *with most advantage* to the *point* of *application*. So with rifling; there being little or no windage, no gas generated by the combustion of the powder escapes; its whole force is applied to the ball, which is, therefore, projected with greater force, and a longer range is obtained than with the musket.

We will now pass on to a more important part of rifling, viz. the twist. From experiments made at Hythe, it was found that by increasing the twist of the Enfield Rifle, increased range and accuracy of fire were obtained. In General Jacob's rifle we find a twist of one turn in *thirty-six* inches; in the Whitworth a turn in *twenty* inches, both of which rifles, in *range*, *penetration*, *figure of merit*, and elevation required for the same distances, are far superior to the Enfield. The figure of merit is easily accounted for, in consequence of the greater revolutions round the axis coincident with its line of flight; but with regard to range and penetration, I have as yet heard of no satisfactory reason to account for it. In my opinion this is mainly owing to the *gradual combustion of gunpowder*. "The inflammation of gun powder," says Straith, "is progressive as in the case of a train, which, being inflamed at one end, burns quickly but gradually to the other; *the principle is the same in all charges*, although the progression is so rapid in small charges as to be imperceptible to our *observation*.".



We now suppose an Enfield rifle loaded. Let *A B D C* represent the charge contained in the barrel. On the part *A O* becoming inflamed and turned into gas, it will cause the bullet and remaining part of the powder to be projected up the barrel, the powder continuing to burn progressively till it be completely turned into gas, when the ball, let us say, reaches half way up. But the volume occupied by the whole gas *at that moment* is much greater than if the *ignition* and *combustion* had been instantaneous; its force is consequently much less, and the bullet is projected with less velocity, consequently a less range is obtained.

Now let us examine how a greater twist is the immediate *cause* of an increase of range and less aberration from the point aimed at. Let us take for example the "Jacob rifle" with one turn in thirty-six. Of course, the greater the turn the greater will be the friction against the lands,* and the powder will take a longer time to overcome both the inertia and friction; but during this time the nearly complete combustion of the powder will have taken place, will occupy a less volume than it would have done in the same time with the Enfield, possess a greater force, and therefore project the ball with a greater initial velocity, causing an increase of range and penetration. Let us add that, the great twist causing a greater number of revolutions of the bullet round the axis of its line of flight, the accuracy will be greater, the air will rush in more freely in the rear, and a diminution of the resistance opposed to the bullet in its flight will be the result. This, I think, is the main cause of increased range and accuracy. As Mr. Boucher most justly remarks, "Inertia and friction are the powers which limit the beneficial application of gun powder within the barrel. By a judicious application of the three, as also the form of the bullet, range and accuracy of fire can alone be obtained, and these must be limited to a certain extent, though General Jacob goes so far as to think that a small shell may be projected to a distance of 15,000 yards!"

I will now revert to Mr. Boucher's theory of the expansion of bullets, and will extract one or two parts from his letter. He says, "the expansion of bullets (having no *projections*) into the grooves of the barrel, or what is often called the rifling of the bullet, is caused by the hinder end being driven on the fore part by the force of the explosion, before the inertia of the fore part is overcome. This is no mere theory unsupported by facts; for during the course of experiments it was proved to the satisfaction of all who were present. The evidence produced also proved the falsity of the Minié expansion principle. In the course of these experiments, and in order to test the theory thoroughly, some hundreds of rounds were fired, with various sorts of projectiles, and with different lengths of barrel, into water, clay, and other substances, so that the bullets might again be collected for examination afterwards. The first shots were fired from a rifle 2 feet 8 inches in length. Then, after firing of a certain number of rounds, from three to four inches were cut off the barrel, until it was shortened to one half the original length. Two inches at a time were then cut off, until the barrel was shortened to one-fourth; after which one inch each time was cut off, and then half an inch, until the barrel was shortened close to the charge.

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* **Sic. Original, Colburn's United Service Magazine for November 1857.**

"The result showed that after a certain length had been cut off, the appearance of rifling on the bullet grew more and more indistinct, until not a vestige of it could be traced. A full charge of powder—the one which was found to be most effective in the field—was used at every round. By beginning at the breech end of the barrel, the evidence may be summed up in this manner. Until the bullet had moved nearly half an inch, no perceptible signs of expansion had taken place, nor were there any traces of rifling on the bullet. Then, however, the faintest trace of rifling, like scratches, could be perceived for about an eighth of an inch, next the base of the bullet. This impression showed itself more distinctly, and at greater length, as the bullet proceeded further until it appeared complete all along the cylindrical part. From the proofs which were exhibited in the earlier stages, the compression of the bullet lengthways, and the expansion of the lead into the grooves, must have continued for some time after, though not discernible on the outside of the bullet. This opinion was further confirmed by the action of the hollow bullets, the cavities of which continued to be more and more contracted as the bullets passed further up the barrel. This was evidently occasioned by the increasing and accumulating pressure of the gases on the hinder end, and the condensed air in front of the bullet.

" The last remark is borne out by the fact that the front part of the bullet, during its earliest stages, is quite as perfect in shape as when it issued from the mould; but as it approaches towards the muzzle, it is resisted by the condensed air in the barrel, and a portion of the conoidal part of the bullet, which was not originally cylindrical, is made so by this resistance, and the great force which presses it on, and this new formation becomes equally well rifled with the rest; so that, in fact, bullets having a conoidal front when put into the barrel, generally leave it with one approaching more nearly to the hemispherical form."

On reading this, everybody must admire the ingenuity with which Mr. Boucher has supported his theory by practical observations. I must say that I differ considerably with him in the " causes." It is mainly owing, in my opinion, to the gradual combustion of the powder, which forced part of the powder up the hollow, caused the bullet to expand slightly until the whole was turned into gas, by which time the complete expansion of the bullet took place, and what was gained in *diameter* was *lost in length.* This last remark will account for the falling in of the cavity, the upper part will do the same, and of course the top part of the ball will assume a more spherical shape. I have no doubt but that the combined influences of the pression of the air and gas may alter the form of the bullet, but only *very slightly.* Were it wholly so, the theory advanced by Mr. Boucher would deviate from a common law of nature, viz.: " The pression of a gas is exercised on every side, vertically and horizontally." According to Mr. Boucher it is only vertical: this alone will prove the falsity of his theory. I have now, I think, proved satisfactorily that the Minié expansion principle is not a false one. Should additional proof be required, let any person get two rifles, one with a greater twist than the other, and proceed with the experiments detailed by Mr. Boucher, and he will find that the expansion takes place much sooner in the barrel with the greater twist than in the other. This last will prove also what I advanced at first with regard to the twist, and the bullet being projected with greater initial velocity.

Time prevents me continuing the subject I have advanced, and I will therefore conclude with one or two passing observations on General Jacob's rifle. In his pamphlet, when speaking of the altered state of his bullet after it is fired, he does not mention whether the bullets were cast or compressed, a great difference existing between the two. In this rifle I should say the altered state of the bullet was mainly owing to the compression of the hinder part on the fore, in consequence of the great twist, but not so in the Minié or Enfield. The great twist in the Jacob must produce a great recoil which would unsteady the hand of any firer, added to which the rifling on the ball must tend to diminish its rotation. To counterbalance these disadvantages, accuracy and long ranges are, no doubt, obtained; and practice alone can determine whether it be a fit weapon to be put into the hands of a soldier.*

I am, &c.,

Fred. J. Adam

Ensign, 22d Regt. B. N. I., and late H. M. 77th Regt.

On the Estimation of Distances in the Field.

Let any one who has ever been "in action" remember what his feelings were, or any one who has not, imagine what his feelings would be, upon first seeing the enemy after many months' expectation. The veteran will have pointed out to his younger brothers in arms, apparently immoveable black lines, which their unpractised eyes may have observed, but have taken no account of. The fortunate possessors of telescopes and of the more modern opera glasses will strain their powers of eyesight to the utmost to endeavour to discover the nature of the troops which the black lines before them, they are told, indicate. Cavalry and Infantry cannot be distinguished—there is nothing but a few black lines to be seen. The excitement attendant upon the announcement that the enemy is in sight, like the cry of the sailor at the mast head after a long voyage, dispels all weariness; the imagination anticipates the future more or less faithfully, visions of glorious victory, never deemed doubtful at this period, appear before the mind's eye; all the aspirations of youthful and sanguine hearts which may have been conceived in the *ennui* of a garrison are, unbidden, once more renewed; the long-wished-for day has at last come. All those whose "hope deferred has made the heart sick," in spite of the absolute presence of the enemy, are still inclined to doubt that an actual general engagement is about to take place. One passing holy thought is given to the idea that the presence of the enemy may be not otherwise than the presence of death; a short prayer is breathed to the Disposer of all events—but the more immediate concerns of the present must be attended to.

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* Colburn's United Service Magazine for November 1857.

Let any one, then, we repeat, recollect what his feelings were. Was not one of the first questions asked, "How far are they off?" We will ask further, was any satisfactory reply to such a question ever given? No, the estimates varied so much that no one felt any confidence in them. Even those who were considered to be best calculated to make them, will have had doubts in their own minds as to the accuracy of their guess, even within a quarter or a half mile.

A gun opens! This attracts the attention of all from the smoke, long before the noise of the explosion reaches the ear. Those who have ever thought of the various methods of estimating the distance of their enemy appeal to their watches. One observer, who, thanks to the fact of our being Islanders, has reached the country in which he is about to fight by ship, gives the moment of observation at the first instant the smoke of the gun appears, by the word "Now," a system which he will have learnt by the method of taking the altitude of the sun daily on board, while the holder of the watch counts the number of seconds passed over by the second hand, until the first observer gives the same word a second time on hearing the report of the piece. A mental calculation gives a rough estimation of the distance from the known rate of travelling of sound.

This estimate is probably more satisfactory to those who make it and to those who hear the result of the operation, than any of the haphazard guesses which have been hitherto made, unaided by any other data than the general and unreasoned impression made upon the eyesight.

Some movement interrupts the cogitations on this subject and, generally speaking, they are never afterwards renewed during the course of the action, excepting by an artilleryman, the figures on whose tangent scale remind him that it is but little use firing unless his piece has the proper elevation given to it.

The above, we opine, is a faithful picture of what has occurred to officers and soldiers on many a field fought in modern times. But since the last war the estimation of the distance of the enemy forms more than a matter of mere curiosity; it now assumes the important proportions of a fact of the highest importance. Our rank and file are enabled to "do to death" an enemy who stands in the midst of his fellows at a distance of 1,000 yards, and this is no small matter. For it must not be considered only how many men may be killed out of a hundred shots at such a distance; but that if a few men only can be thus "put past fighting," the moral effect—the effect upon the mind of each individual—will be of vastly greater importance; the respect engendered for the opponent will be considerably augmented, far out of the proportion of the loss inflicted, or even of the number of bullets which whistle past. Further, the distance is a matter which has the greatest influence on the accuracy of the practice of the artillerist. To enable him to adjust his fuzes, he must know how many seconds it will take the explosive projectile to reach his enemy; and he must be equally cognizant of that distance to know what elevation he should give his piece. Lastly, it is of no small consequence to the general and staff officer to know how long it will take a body of the troops under their direction to reach the enemy; and not less, to know in what length of time a similar body of the enemy's troops may reach them. In short, it is a datum which is absolutely required in all calculations in the domain of tactics and of siege operations.

We propose, therefore, to present to our readers in a short space the present state of the question; what the principles are upon which the attempts at a solution of the problem have hitherto been made, what are the means and operations made use of in the solution, and, finally, what trust may be placed upon the results obtained.

We cannot do better, we conceive, *in limine*, than quote the observations on this subject which appear in a Prussian work on field artillery lately published.* The author says:—

" The efforts at constructing a serviceable instrument for measuring distances for field artillery have hitherto met with little success. Endeavours are still being made to contrive an instrument, which, from a single station, should indicate distances up to 2,000 paces with adequate accuracy, without any calculation, and such as may be used on horse-back. The instruments and telescopes hitherto invented, which can be used from a single station, are based upon this principle,—that the height of an infantry or cavalry soldier is taken as the base of a right angled triangle, whose perpendicular side is the distance sought, and the angle under which it is seen is measured by the instrument. We may easily see that the determination of the distance upon such a principle is subject to the following objection, that there exists no just proportion between the base and the perpendicular of the triangle, and, consequently, that the angle under which it is seen is very small. Distance measurers constructed upon this principle determine distances beyond 600 paces (500 yards) with but little accuracy.

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* " On the use of Field Artillery on Service," by Taubert. Translated by H. H. Maxwell Berlin, 1855; John Weale, London, 1856. Pages 74 and 75.

It appears, then, that all the instruments which have been invented for determining the distances of objects of a known height, such as an infantry or cavalry soldier from one station, measure a *vertical* angle. We may add, that with all the instruments which are used from two stations, or where the distance is to be determined from two stations without instruments, the angle measured is an *horizontal* one. The instruments for the purpose in view divide themselves, thus, naturally and for us conveniently, into two classes, viz.:— those in which the *vertical*, and those in which the *horizontal* angle is measured.

(a). *The vertical angle.*—This class includes all telescopes, stadia, and analogous instruments. Cavallo's micrometer is thus described.* It " is a fine transparent scale divided on mother of pearl, which can be applied to any telescope. To form a table of angular values; since an object six inches wide subtends an angle of 30 minutes, at a distance of 57 feet. 3·5 inches, observe how many divisions of the scale are covered by it; this number divided by thirty, gives the angle for one division. Or set up a 10 feet rod, and, measuring off distances from it, observe how many divisions it covers at every 100 yards; as, then, the average height of a man on horseback may be taken at 8 feet; of a man on foot, 6 feet; of a gun wheel, 5 feet; the distance corresponding to the number of divisions either of these objects covers, taken from the table made for 10 feet, being multiplied by ·8, ·6, or ·5 respectively, will be its distance. So of any other object of known dimensions. Rochon's micrometer is a superior but more expensive instrument." The same instrument is used in the Swedish artillery under another form. It is possible that it may be "Rochon's" instrument referred to, of which we have not met any description.

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* Handbook for Field Service, by Lefroy, 1854, pp. 143, 144.

The Swedish instrument is thus described*:—

"Each battery is provided besides with a reflector and a stadium, or instrument for measuring distances. This stadium is a telescope which does not magnify, but simply renders the objects viewed more distinct; on the object glass are two points, provided with a mechanism which enables the observer to make them approach or recede from each other at will."

"When an observer wishes to use the instrument to determine the distance between him and any given point, he causes the two points to move until they exactly include the height of a cavalry or infantry soldier; he then reads, on a graduated limb, the number of yards corresponding to the angle under which the soldier has been seen."

"The theory of the instrument is based on this principle, that the image of the object depicted on the object glass is to the object itself in the same proportion as the length of the telescope is to the distance of the observer's eye from the object observed; the scale is graduated, admitting the height of the infantry and cavalry soldier to be 6 feet and 9 feet, Swedish (5·82 and 8·73 British feet) respectively."

This instrument seems to be a more practical one than the first described, as it has this great advantage—that it is easier to bring two points together, by means of a mechanism *ad hoc*, to include a figure a long way off, than it is to determine the number of divisions of a minute scale which shall exactly cover the like figure. It is necessary with the former, too, to make an arithmetical calculation ; but it has been found that the field of battle is a scene not well calculated to ensure accuracy in such computations.

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* Etat Actuel de l' Artillerie de Campagne Suedoise, par Jacobi; translated by Lenglier, Paris, 1849.

The writer of this article had the opportunity of seeing last summer in Switzerland a new telescope, in the hands of its inventor Mr. J. Goldschmid, an optician of Zürich, who informed him that an arrangement for taking out a patent or registration for it in England was all but completed. He has either done so, or by this time abandoned the idea; under these circumstances there can be no objection to making it public. The instrument, which he has named a "circle diastimeter,"* he says, has the advantage over the common micrometer telescope (the first described) of having no table to consult, such as is used with those instruments to save calculations: he replaces it by a divided disk, having the different hundreds of paces or yards graven on it, to which an index points when observing, so that the distance is read off by simple inspection—from 200 up to 3,000 paces. He avoids using any species of scale to measure the height of the soldier. He thus describes his idea:—

The circle *a, a,′ a,″* (Plate 24, fig. 1) exhibits what is seen on looking through the telescope. The point *b* is an immovable sight point; *c, c,′ c,″* is a spiral line traced with a diamond on a piece of plain glass. If then the soldier, as seen at 200 paces, appears to be included between the sight-point *b*, and the curve at *c*, giving the height *bc*, at a longer distance (Fig 2), in the inverse ratio he will measure a shorter height, and be included between *d* and *b*, measuring the height *d b*. The instrument is so constructed that the act of moving the curved line to

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* διάστασις-μέτρου

On the Estimation of Distances in the Field.

Fig. 1.

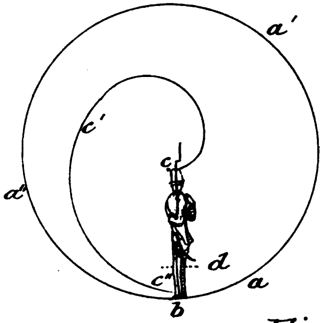


Fig. 2.

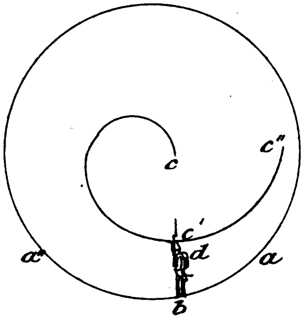


Fig. 3.

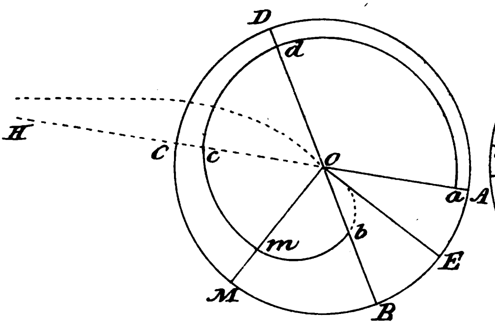


Fig. 5

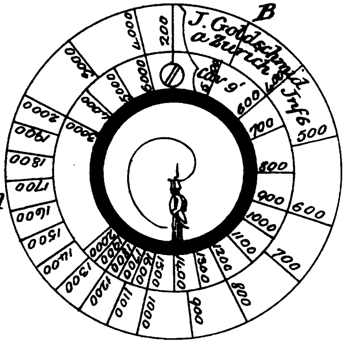


Fig. 6.

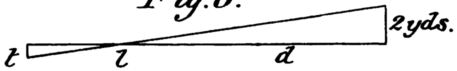
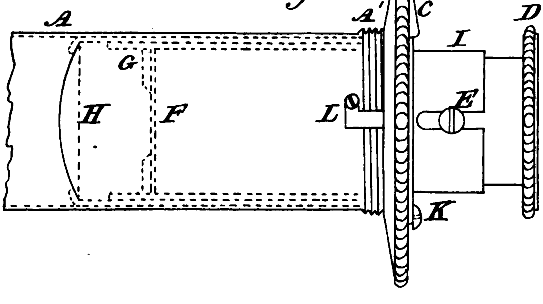


Fig. 4.



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adjust the apparent height of the soldier between the curve and the sight-point, simultaneously carries round with it an index, which gives the corresponding distances upon a disk. The distance, then, is measured by bringing the object between the immoveable sight-point, at *b* and the curved line, which is turned round until the latter cuts the highest point of the object *d*. The index points to the number of paces (or yards) on the divided limb, the division of which must be executed in an empirical manner.*

The construction of such a circle-diastimeter, he continues, has been so contrived, that it may be applied to any telescope. His description of it is as follows:—

Fig. 4. *A*, *A*,′ is the first draw of the telescope. *B*, the divided circle, giving the distances in paces of $2\frac{1}{2}$ feet (or in

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* A friend of the writer's has been good enough to investigate the equation to the curve as follows:—The distances are measured along the circumference $A\,B\,M$, (fig. 3) and the lines $B\,b$, $M\,m$, ... are taken proportional to the apparent magnitude of the object. Let A be the point in the circumference from which the distances are measured; B any given point, to the height of the object in the instrument, $B\,b$; M any other point; $M\,m$ the height of the object. Let the radius vector $O\,m$ of the curve $= r$, $\angle\ A\,O\,B = a$, $\angle\,A\,O\,M = \theta$. Radius of the circle $O\,A = a$, and given height $B\,b = b$. Then by the question.

$$B\,b : M\,m :: \frac{1}{\text{arc } A\,B} : \frac{1}{\text{arc } A\,M} :: A\,M : A\,B$$

Or $$b : a - r :: \theta : a$$

Hence $$a - r = \frac{b\,a}{\theta}$$

which is the polar equation to the curve.

This curve has nearly the same equation as the hyperbolic spiral; and it will easily be seen that the circle is an asymptote to the curve, or the curve will approach continually nearer to the circle, but will never reach it. As it may be curious to trace the curve beyond the limits of the instrument, *pour finer les idees*, as the French say, let $A\,B$=60 degs., and $B\,b = \frac{1}{2}B\,O$. Then $M\,m$ will $= \frac{1}{2}B\,b$; $C\,c$ will$= \frac{1}{3}B\,b$; $D\,d = \frac{1}{4}B\,b$; and $A\,a = \frac{1}{6}B\,b$. Take $A\,E$=30 degs., then $E\,e$ will=the radius $E\,O$; the curve will then pass through the centre O; and at an angle of 15 degs. from A or C, it will cut the circle, and $A\,O\,H$ will manifestly be an asymptote to the curve. This case applies only when the distances, represented above by a number of degrees of arc, are in the proportions of 1, 2, 3, &c. In the instrument itself it will be observed that this is not the case, the graduation being made empirically.

yards). *C*, the index. *D*, setting of the first eye-glass, which can be moved in or out, to get the correct focus. *E*, fixing screw for the setting *D*. *F*, plain-glass and curved line. *G*, diaphragm, with the sight-point *b*. *H*, second lens. *I*, moveable tube to which the index and the spiral or curved line, &c., are affixed, having the plain-glass at the end *F*. *K*, a small screw securing the tube *I*, and by which the latter is prevented from being withdrawn from the sliding tube. *L*, bayonet-joint, by which the circle-diastimeter is prevented from falling out of the draw-tube of the telescope.

Fig. 5 gives a front view of the divided disk, as well as of the index; the fixed sight-point and the curved line just including the height of an infantry soldier as seen through the telescope at 200 paces. The division of the disk was made empirically, by placing poles at every 100 paces along the line of railway, between Baden and Zürich, up to 4,000 paces, the poles being 6 and 9 Swiss feet (5·9 and 8·8 British feet) respectively, for the cavalry and infantry scales.

There is another kind of telescope having hairs stretched across the field of view, at right angles to each other and placed at unequal distances one from the other. The figure of a soldier is fitted in between the two pairs of hairs which correspond to the distance at which the object is situate, which may be read on the outside of the instrument.

The above instruments are all subject to the same objections—namely, that they must be held very steadily to give trust worthy results; consequently that they are useless on horseback; that the difference between selecting a man of five feet five inches or six feet as the object of observation will form a very great element of error in the result, as will the nature of head-dress worn by the soldier, varying between the diminutive *képi* and the gigantic bearskin. The circle-diastimeter telescope is open to the further objections, that the fact of a piece of plain glass (whereon the curve is traced) being inserted into the tube, prevents a certain portion of the light from reaching the eye; and that the object observed is at the edge of the lens, where the picture is of course not so clear as in its centre. These objections, however, are of no great practical importance, as far as the writer can judge from having used the instrument three or four times.

The same principle is made use of in instruments called stadia, intended to be used at shorter distances. As these instruments are now very well known, it will suffice to say that they consist of a piece of card board or sheet brass, having an isosceles triangle cut out from the material, the base of which bears a very small but known proportion to the height (usually 10 to one). A calculation of the simplest nature is then made to find out what the apparent height of an infantry soldier would be, projected on a plane, at a distance equal to that from the eye to the thumb at the end of the extended arm (usually between twenty-five and twenty-six inches.)

This calculation being made for every hundred yards, it suffices to fit the heights thus obtained between the sides of the isosceles triangle and to write the distance on the stadia to complete the instrument. This should be effected before cutting out the triangle, when it may be done with very great accuracy. The same operation should be performed on the opposite side of the stadia for a cavalry man. To insure the instrument being always held at the same distance from the eye, it is usual to have a piece of whipcord attached to the stadia, the other end of which has a button fastened to the cord, at the distance for which the instrument is calculated. The instrument being held upright in the left hand, the right hand holding the button close to the eye, the figure of a man is fitted, as it were, between the sides of the isosceles triangle, and the distance at which he is situated is read off the stadia. With such an instrument, distances can be estimated up to 500 yards with tolerable accuracy, but beyond that the results are far from trustworthy, as the apparent height is so small that it becomes difficult to hit the exact point where that height fits. This instrument is made sometimes in the shape of a Minié rifle sight, with a sliding bar, which is moved up and down at pleasure, until the apparent height of the soldier can be fitted in between the sliding bar and the bottom of the open space between the two perpendiculars of the sight; the distance is then read off the perpendiculars.

The objections we have opposed to the telescopes above, as regards the difficulty of holding them steady, and the variation in the height of soldiers, are equally valid against all instruments similar to the stadia described. We now come to the tangent scales of guns as instruments for measuring the vertical angle under which objects are seen; and here we find the great advantage of having a firm stand—the gun and carriage—to support the instrument. Further, as the lengths of guns are considerable in comparison to those of telescopes, the radius and consequently the tangents of the angles measured is larger, and thus less subject to error. At the same time we have not the benefit of the optical power of the telescope in making use of the gun for this purpose.

The method of using the tangent-scale for the measurement of distances, proposed by Lombard, may be thus described* :—

The gun is laid by line of metal at the top of an object six feet (two yards) high—a foot soldier, for instance. The tangent-scale is then raised until the visual ray, passing through the notches on tangent-scale and swell of the muzzle, cuts the foot of the object. Enter the table below with this height (which must be accurately measured), according to the nature of the piece, and read the corresponding number of yards in the first line of figures:—

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* Adapted to the English service from the system explained at page 433 of the "Aide-Memoire a l' Usage des Officiers d' Artillerie." Paris, 1851.

Angles under which an object two yards high is seen, and Tangents corresponding to those Angles, at a distance of (Yards.)—

	200	300	400	500	600	700	800	900	1000	1100	1200
Angles.........................	34′ 23″	22′ 55″	17′ 11″	13′ 45″	11′ 28″	9′ 49″	8′ 36″	7′ 39″	6 53″	6′ 15″	5′ 24″
Tangent for Guns............	inch	inch	inch	inch	inch	inch	inch	inch	inch	inch	inch
24-pounder (iron).......	1·116	·744	·558	·446	·372	·319	·279	·248	·223	·203	·186
18-pounder	1·066	·711	·553	·426	·356	·304	·267	·237	·213	·194	·178
9-pounder (brass)......	·704	·469	·352	·282	·235	·201	·176	·157	·141	·123	·117
6-pounder	·591	·394	·295	·236	·197	·169	·148	·132	·118	·107	·099
Tangent for Howitzers.											
8 inch (iron)...........	·465	·310	·232	·186	·155	·133	·116	·104	·093	·084	·078
24-pounder (brass)......	·556	·372	·278	·220	·185	·159	·139	·124	·111	·101	·093
12-pounder	·444	·296	·222	·178	·148	·127	·111	·099	·089	·081	·075

N. B.—If the decimal point in the first column be moved two places to the right, the figures will then represent the lengths of the pieces, in inches, from base ring to *back of* *muzzle notch*, and it is these lengths that have been used in calculating the above table.

To the use of the above table it will probably be objected to us that the British tangent-scales are divided into whole, half, and quarter degrees, and not into inches and tenths. To this there are two methods of replying: first, that every battery is, or ought to be, provided with a Gunter's scale and compasses, and that the measurement on a diagonal scale to the hundreth part of an inch presents no great difficulty. The second method is to divide the *back* of the tangent scales, agreeably to the numbers in the above table, in the Arsenal before they are issued, and above each line of such divisions to write the number of 100 yards, to be found in the first line of the same table. Thus the same instrument which serves to elevate the gun would, at the expence of a little engraving, serve the additional and very important purpose of measuring the distance of the enemy; and this suggestion we beg to make most respectfully to "the Authorities that be" in the various British artilleries.

To compress the above table into a formula portable in the memory, we will refer to a figure:—

Let l (Fig. 6) be the length in inches of the piece, d the distance of the object in yards, and t the tangent of the angle under which an object six feet (two yards) high is seen; then these triangles, having the vertical angles equal, and having each one right angle, are similar, and—

$$t : l :: 2 : d$$

$$\text{or } d = \frac{2l}{t} = \frac{l}{\frac{t}{2}}$$

Or to put it into words:—

"Divide the length of the gun (in inches) by half the tangent (in inches), for the distance of a six-feet object, or soldier, in yards."

If time and circumstances permit of measuring a distance of about 100 yards and no instruments are available, a man with a pole—a spunge staff for want of better—should be sent to each end of such measured distance which should lie between the object and the observer; take a height of five or six feet on that furthest from the object, and make a mark at both ends of this height; in like manner make two similar marks on the second staff, where the visual rays starting from the marks on the first staff cut the second. In this manner the terms of a proportion are obtained, from which the distance may be learnt.

(b.) *The Horizontal angle.*—In measuring this angle there are two methods adopted, the one being a direct measurement by a scientific instrument such as is used in surveying, the other by intersection and prolongation of lines in particular directions. With reference to the former, the author before quoted says, "another class of instruments for the purpose, which require two stations for the determination of the distances, besides certain operations in the field, give a sufficiently accurate result, but a very general opinion obtains that they are too complicated for use on service."* As to the latter methods, a general idea of them will perhaps be understood by saying that these operations generally consist in forming two similar triangles, of which the base of that nearest the enemy and any parts of the other triangle may be measured; a simple proportion gives the leg of the furthest triangle or the distance. Into these operations we shall not enter, because they are well known to every one who is familiar with surveying, and they may be found in almost every book which treats of field-operations. We shall satisfy ourselves by making the remark that the horizontal angle can rarely be made use of in a general action, but in prolonged operations, such as sieges, passages of rivers, &c., this method is the best and of most general use.

Distances may be estimated without instruments with sufficient accuracy, provided the observer shall have taken the the trouble previously to educate his eye by constant practice, and it is surprising to what an extent this education may be carried. The best method of doing this, perhaps, is to get possession of some unit of measurement, say 100 or 200 yards, and to fix it firmly in the memory, and then to apply it to the distance to be measured, and thus estimating how many times it is contained therein. But to make this latter estimation requires as much practice as to fix the unit.

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* Taubert, page 75.

In taking a walk along a straight road, or in an open field—"a constitutional," let us suppose—this method may be employed with great satisfaction and profit. The *natural* length of pace—not the military pace—should be previously ascertained by measuring one hundred yards accurately with a tape or chain, and then walking this distance to and fro repeatedly, and the mean number of paces calculated for the distance. While effecting this preparatory operation the eye will gradually become acquainted with the effect of various objects at one hundred yards, and the observer will have become enabled to pace out that distance with accuracy at any future period. In taking his "constitutional" let the observer walk the number of paces answering to one hundred yards and look back to his starting point to freshen his memory. Let him then fix upon a distant point, where he supposes his imaginary enemy to be situated, and then endeavor to make out how far one hundred yards would reach on that line, then another hundred, yards, allowing a less *apparent* distance on the road, and so on till he has made his estimate of the whole distance.

He may now resume his walk, counting every alternate pace, as that is found to be the most convenient plan, and doubling down one finger at every hundred yards. When arrived at the point where he had placed his imaginary enemy, he will discover how far his estimate was a correct one. Let him now look back to the starting point and remark how objects look at the whole distance. If he will then take the trouble of noting in his pocket-book the number of yards of the actual distance of the estimate, and of error, and make a short calculation of the percentage of that error, he will thus from day to day be able to form some idea how the education of his eye is progressing, and, generally speaking, it will be found to make surprising advances up to a certain point.*

In our regiments of infantry this instruction is conveyed to men of all ranks by placing soldiers at every fifty yards and teaching the men to remark "what parts of the figure, dress, and equipments are clearly perceivable, those that are seen confusedly, and those which are no longer visible." These are different for almost every eye, and therefore general data are of little value. But, by way of giving a general idea of what *can* be remarked in bodies of troops, and to which the attention should be directed, we have extracted the following from the best sources :—

Good eyesight recognises masses of troops at 1700 yards ; beyond this distance the glitter of arms may be observed. If, therefore, neither colour, files, nor uniform can be made out, we may be sure that our enemy is beyond that distance. At 1300 yards infantry may be distinguished from cavalry and the movement of troops may be seen ; the horses of the cavalry are, however, not quite distinct, but that the men are on horseback is clear. A single individual detached from the rest of the corps may be seen at 1000 yards, but his head does not appear as a round ball until he has approached up to 700 yards; at this distance white cross-belts and white trousers may be seen. At 500 yards the face may be observed as a light coloured spot ; the head, body, arms, and their movements, as well as the uniform and the firelocks (when bright barrels) can be made out. At between 200 and

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* This system cannot be carried on, however, to very long distances, because the eye sees the distant ground so obliquely that no accurate estimate can be hoped for. However, with sufficient practice, the error, up to 800 or 900 yards, ought not to exceed one-tenth.

250 yards all parts of the body are clearly visible, the details of the uniform are tolerably clear, and the officers may be distinguished from the men.

Great attention should be paid to the amount of light by which the landscape is illuminated, as well as to the state of the atmosphere, as objects will appear very different at the same distance when seen on an ordinary bright day, a dull day, through a fog, or immediately after rain; whether in the broad day light or in the gloaming. There are certain matters connected with perspective which should not be neglected. An avenue of trees, or the telegraph posts of a railway, or the like, are likely to mislead the judgment, and the distances will probably be estimated at too high a figure. Again, the same effect is produced by looking across a valley, a ravine, or a piece of water.

The dust thrown up by projectiles ricocheting on dry ground may be seen up to between 900 and 1,000 yards. This for the artillery man is perhaps the very best method of learning the distance, but he should be careful in the first instance to lay his piece low, otherwise every shot thrown beyond the object will not serve him for the purpose.

There is one more method of estimating distances without instruments, which will afford an approximate result, but at best it is but a very rough one, as we shall have occasion to prove. This is the difference in velocity of light and sound, the ratio between them being so enormous (say 704,000 : 1) that the time which a ray of light would take to pass from an object at 2,000 yards' distance may fairly be taken as instantaneous. The velocity of sound varies according to the temperature of the atmosphere. At 50° F. it moves through 368 yards in a second, the increment or decrement for each degree of Fahrenheit may be taken at $\frac{4}{10}$ of a yard (more correctly ·379 feet). These figures are, perhaps, not easily carried in the memory, but let us say that at 42° F. sound moves through 365 yards (the number of days in the year), and that for every ten degrees we must add four yards to the rate, and it will not be difficult to remember. In January, 1854, the writer of this paper happened to be at Calafat, where the Russians had closely hemmed in the Turks in their entrenchments. On one occasion our late enemies opened a battery of field pieces (12-pounders), *pour passer le temps,* we must suppose, at an enormous distance. An Officer of the Sardinian Staff gave the word as mentioned at the beginning of this paper, while the writer took the time. The observation was repeated several times, and the mean of the observations of the flash and the report was 11 seconds. We had no thermometer with us, but as there was snow on the ground and the sun was shining, we may estimate it at 42°, which would give us 4,048 yards. To estimate the correctness, or rather incorrectness, of this calculation, we shall state that one of our British nine-feet 18-pounders fired at forty degrees of elevation, with a charge of four-and-a-half-pounds of powder, ranges 4,000 yards; and, consequently, that the Russian 12-pounder brass field gun of 6·2 feet, could not have thrown up to such a distance, even had they sunk the trail to the utmost. Our error was probably not under 1,000 yards. Others, however, may have been more expert and successful in their observations.

On reviewing the various methods of estimating distances which we have above detailed or alluded to, we come to the conclusion that in actual action in the open field the naked eye is fully competent, when properly educated, to give sufficiently accurate results. We would, therefore, beg to recommend every soldier to look upon it as a most important duty to practice his eye, not only in estimating distances, but heights also. To aid him in doing so it would be well to mark in legible characters various lengths on barrack walls, the height of military buildings, &c., so that he would constantly have before him units which he could always refer to, and with which his mind would gradually become familiar. These would become his standard, which he would apply in time of need.*

M. L.

Mantelets in Field-Batteries

To the Editor of the United Service Magazine.

Sir,—In consequence of the great improvement which has taken place of late years in fire-arms, especially in rifles, it has often struck me that some additional precautions should be taken to prevent, or at any rate diminish, the chances of casualties amongst the men and horses attached to the field-batteries of the artillery. It is not from any over anxiety for their personal safety that I now send you the following plan. The artillery has, I am proud to affirm, always done its best to support the honor of our country, but anything that tends to preserve the efficiency of men and horses in an army really adds to its strength. The plan I propose of mantelets is not intended for horse artillery, but only for field-batteries of 9-pdrs. and 24-pr. howitzers, or 12 pounder brass guns.

It may be urged that these mantelets will be an encumbrance, and diminish their power of rapid movement; but on any emergency they can be dispensed with, especially when attacking; only when in position, or when on the defensive, such a protection may save some valuable lives. The rope netting used by the Russians in their embrasures was found to be extremely useful; perhaps this would be too weighty, but two thick ox-hides, hung loose, at an inch asunder, would stop many spent balls which otherwise might wound the men at the guns. I should also suggest that the ammunition-box of the limber should open at the back instead of the top, as at present: this would obviate the necessity of the gunner serving out ammunition exposing himself more than absolutely necessary to the enemy's marksmen; also that, on coming into action, the gun limbers should always reverse, so as to bring the horses' heads to the rear, and interpose the limber between them and the enemy; the drivers should also immediately dismount. It must clearly be understood that these mantelets are not expected to resist round shot, or even musket-balls at close ranges, but merely spent balls, and to prevent rifle-men picking off individual men at the guns. When there is a chance of a battery remaining in a position for any time, the greatest care should be taken to screen the limbers and ammunition waggons: the enemy's marksmen might at times be misled by green brushwood piled along the front of the battery; this is, of course, when field-works are not advisable.

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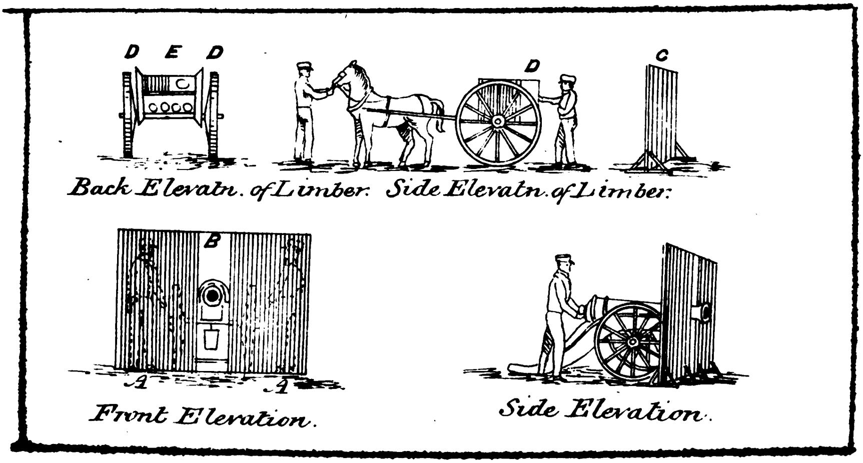
* Colburn's United Service Magazine for June 1856.



Back Elevatn. of Limber. *Side Elevatn. of Limber:*

Front Elevation. *Side Elevation.*

A A two mantelets, 4 feet by six feet, formed of iron frames; the stanchions at the feet movable by hinges for the convenience of packing; those for the guns are also connected by cross bars *B B*; the frames are covered with 2 ox-hides hung loose.

C Mantelet to cover gun-limber, 6 feet by 5 feet. *D D* doors of ammunition-box, with shot and shell below and copper magazine above *E*.

To each two guns or howitzers a light cart should be attached, to carry the mantelets, four for the guns and two larger for the limbers; this cart could also carry all intrenching tools.*

Your obedient servant,
AN ARTILLERY OFFICER.

London, 25th June 1857.

Remarks on Field Artillery

To make any remark upon the system of British field Artillery will doubtless by many be considered uncalled for, especially after the many hard-earned laurels gained by the corps of artillery in general during the late war. To this we would reply, that it is to field-artillery alone we would confine our comments, which department cannot be said to have been so extensively employed in the Crimea as to render unnecessary (from actual experience) any alteration in its present equipment.

It may be advisable to state, for the sake of the uninitiated, that field-artillery consists of horse-artillery, field-batteries, and batteries of position, to which we may add batteries of reserve, being a mixture of all three according to circumstances.

Firstly, horse-artillery consists of guns (six-pounder or nine-pounder) and howitzers, wagons, horses, carriages of various natures, and are similar in equipment to the field-batteries, with this exception, that a troop of horse-artillery is allowed sixty more horses to mount their gun detachment, whereas in the field batteries the gunners walk with their knapsacks on, when accompanying their respective guns, whether on parade, the line of march, or in the field of battle.

Batteries of position generally consist of twelve pounder guns with 32-pounder howitzers, or eighteen-pounder iron guns with eight inch howitzers, and from their name may be understood to occupy in action certain posts of importance to the defensive operations of the army, also to strengthen any point of apparent weakness in the line of battle, &c., and are seldom expected to move before the enemy.

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* Colburn's Magazine for September 1857.

Having briefly enumerated the various branches of field-artillery, it next becomes necessary to review the parts alloted to each in the theatre of war. Horse-artillery are intended principally to act with and support cavalry in their offensive measures, and to protect its retreat in case of disaster; it can keep pace with that arm in its most rapid movements, from having its gun detachments mounted; it is also useful as a reserve, from the celerity with which it can be brought to any point required to be defended or attacked. Great advantage must therefore arise to an army from the addition of a large force of this nature.

Much has been said by many experienced artillerists against the maintenance of this corps, who have stated that field batteries will perform the duties required of horse artillery, if they are but allowed. To this all thinking men will not agree, at least in the present hampered state of the former body, whose duties we would now seek to show as briefly as possible, viz.: to attend upon the operations of infantry, to cover them when advancing, retiring, or deploying into line.

If the Infantry should advance after deployment, the artillery must gain ground to the front, in order to move to the flank, so as to uncover the troops as they deploy; when the infantry retreat, the guns must form on their rear to protect them, retiring alternately, and keeping up their fire on the enemy to check his advance.

These are but a few examples of the duties of field batteries, but we trust they will be sufficient for the object in view.

It has been already stated that the gun detachments of the field-batteries march along side their guns, with packs on, and are expected to keep up with them in every movement they are called upon to make, as well as to work the guns when brought into action. This must seem to any one who will take the trouble to analyze the subject (of deep importance) to be an almost superhuman effort for the animal man to make, notwithstanding that the gunner is expected to be a stouter specimen of humanity than his brethren of the cavalry or line. We would fain again revert to the duties which we have here stated are required from field-batteries in connection with infantry; from these it must seem evident that the guns are called upon to move quicker and smarter than infantry upon almost all occasions. If guns are required to change front on a flank, the gun of the reverse flank must move at a trot; were a battery ordered to change front to the rear on its own ground, the flank guns would also have to trot. To mention the many occasions upon which guns are required to move "*at an increased pace*" as the battery exercise *modestly* directs, would require more space than can be given here; and be it remembered that during these movements the gunners have to do their best to keep up, and when the formation is effected the detachment will at last doubtless come straggling on, the victims to heavy marching order, and will arrive at their guns blown and unfit for duty, just at the moment they are most required to be fresh, to work the gun in action.

They will then assist to unlimber, by which is meant to detach the gun and carriage from the limber, by means of lifting the trail eye from off the hook on the limber, and to carry it to the right, left, front, or to drop it at once, according as it is required to come to action. The lifting of this trail is performed by three men of the detachment, Nos. 1,6 and 8, the weight of which for a nine-pounder is about two hundred and seventy-three pounds, and will consequently give each man a lift of ninety-one pounds, and this in heavy marching order, with men already exhausted by keeping up with their guns. Other numbers at the gun have to double to the rear for ammunition from the wagons, and upon their speed must mainly depend the rapidity and consequent good effect of the artillery fire.

A great deal has been said from time to time with regard to the infantry soldier being overburdened, on the propriety of which it is not our province to speculate. But we ask, what can equal the arduous task of the gunner, who is required to perform the manœuvres of the infantry as well as those of his own particular arm, either one of which might be sufficient to expect from human powers? To this but one reply can honestly be given—we say *honestly*, for it is to be feared that jealousy and prejudice have been in a great measure the cause of the many evils to be lamented in the field battery system.

Can nothing be done to remedy all this? The answer would be, that some plan should be formed to obviate such over exertion on the part of the gunner, for as it is he cannot perform the duties required from him in action, leaving aside all injury to the individual men and consequent loss to the service; for it must not be forgotten that by the time that the artilleryman is able to serve a gun in the field, he has cost the public a round sum to bring him to that state. Many will say that, for all extraordinary movements requiring increase of speed, the gunners can be mounted on the ammunition wagons, and which they are taught to do on some occasions but orders are expressly laid down by which the wagons are not allowed to proceed under fire, and it is almost only when under fire that the additional rapidity is required. Moreover it is against the rule of the service to do so, and very properly. We cannot explain the matter more clearly than by quoting an order issued by his Royal Highness the General Commanding in Chief, who has shown upon this occasion, as upon all others, a firm consistency of opinion and intimate knowledge of detail; the order runs as follows:—

" His Royal Highness the General Commanding-in-Chief, while expressing his approbation of the appearance and movements of the field-batteries at Woolwich, on the 13th Instant (13th August 1856), desires it to be understood that the practice of mounting the gunners on the limbers and wagons in quick movements has his sanction only for the purposes of driving drill and marching past at a trot. On all other occasions, and when acting with other troops, the gun detachments will move in the order of march as on active service in the field; where it is manifest they could not be carried into action on the ammunition-wagons without bringing the wagons under fire, even if the tent equipage, corn, and forage, &c., carried on them, did not interfere to prevent it."

An order coming from so high a source must at all times to a soldier command respect; how much the more so when it is found to contain matter of such sterling sense and truth! The state of the field battery system required it, which was rapidly gaining the idea that the detachments might mount the wagons upon all occasions upon which it might suit the taste of the commander to order it, which idea was a deception to themselves, and to the injury of their effective operations in the field.

We have hitherto spoken of field-batteries as in connection with infantry, but that is scarcely considering the matter in all its phases, for the exigency of the service may sometimes demand them to cooperate with cavalry, when no horse artillery can be got at, and which in the British service must sooner or later arise from the paucity of that arm. It were absurd to comment upon this case, as it must be judged by its merits at a glance; its mere announcement is enough to show how ridiculous it is to expect that such a combination can be looked for. We would not envy the position of a battery ordered to act with a body of cavalry; the attending circumstances must prevent each arm from deriving the mutual support from the other which they have a right to expect, and without which their combination wonld be next to useless.

We trust that such a service may never be required from our field batteries of the present day, It is, however, best to consider the matter under circumstances that may frequently occur if nothing is done to prevent it; and in discussing this matter (of such moment) we would endeavour to take a dispassionate view of things as they exist, and to attempt to awaken the minds of those who should be most interested in the efficiency of our artillery, who, we fear, if they have considered the subject, have scarcely thought of it in all its aspects, but have laid it aside, perhaps for after thought; but we fear not, for improvements in our service are scarcely ever effected until stern necessity shows itself, when sudden war points out the neglect with which we have treated a long lapse of peace, when we shut our eyes to advancement, and trust, humanly speaking, in the sufficiency of the day ; doubtless a good rule in a moral point of view, but scarcely sufficient for the requirements of a great nation whose possessions are to be found in most parts of the habitable globe, for the maintenance of which a struggle may some day arise, as it has done now in India, when we put our trust in British pluck and bayonets, regardless of all opposing forces : and truly it is a great and noble trust, and gloriously earned on many a bloody field. But is this sufficient for our national safety ? In former days the strength of an army depended mainly on the number of knights and men-at-arms ; the rest of the forces were thought of quite as a secondary consideration. Science has now taken the place of the knights, and is armed "*cap à pie*" to resist all comers, and must succeed in placing modern armies on a parallel according as they possess it in a greater or less degree. For what can withstand the crushing effects of fire from a numerous and powerful artillery which is concentrated and directed against any point of the enemy's line ? We speak not of the small force of field-artillery that has generally accompanied the British army, but of what *might* be made up for the purpose, and which could well afford to detach, as a reserve to be brought to bear on any particular position, some ninety or a hundred well appointed field-guns. This may seem a large force to demand, but it is one that has already been proved irresistable when properly handled. We urge it not unadvisedly, for examples can be given where its terrible destruction well told, and it stands to reason that such must be its effects again.

By these observations it is not sought in any way to disparage the British bayonets, for it would be difficult to find cause to do so were we inclined. No; a soldier's duty points not in that direction, but to move all his powers towards the advancement of the service to which he has the honour to belong, not to imagine or write that this or that is the principal arm of the service, to awaken jealously and ill-feeling by so doing. Union is strength, and it is only by this that great ends can be obtained, to the improvement of military science and the true interest of the army. Our purpose here is to open up the way to our gallant infantry to save them from utter destruction which their indomitable valour could not avert, were the enemy to take but the means mentioned to effect it: under such circumstances our battalions must be mown down, unless indeed we can produce a greater force of artillery than that opposed to us.

To this modern tactics must more and more tend, for as the march of intellect progresses so must the means of destruction increase, until war becomes a conflict of mechanical science, which is we think not saying too much, for it has been going on in times past and present more or less, and to the future we look for its perfection.

It has been our endeavour so far to show the importance of a well-organized system of field-artillery towards the decisive operations against an enemy, as well as to protect ourselves from a like attack and turn the tide of battle in our favour.

To effect this, we must reorganize and place our field-batteries upon another footing, or we should perhaps better say *sitting*, for we have in some measure shown that the foot system wont do; and as it is impossible to carry gun detachments upon the ammunition wagons, we would suggest that they might be carried on something else that would not offer the same objections. Perhaps the reader may think we mean to use horses alone for this purpose, and say we would wish to turn every thing into horse-artillery;—not so. Respectfully would we suggest for the purpose a light car or carriage, as may hereafter upon consideration be deemed most advisable, and drawn, we will say, by four horses, upon which carriage the men might sit with ease, and stow their packs under the seats; stores also of various descriptions might be carried on this carriage, which at present hamper both guns and wagons. In case of a gun-carriage being disabled, it might be made available to carry off the gun in safety; it could with ease go any where a gun could go, and in drill or exercise should take the position which the wagon at present occupies, which latter carriage would more properly be placed in rear of the battery to look on, and not to take part in the evolutions of the guns (as at present,) which could never be done while under fire, putting aside the unnecessary jolting to the ammunition, which cannot be said to improve it. By these means field-artillery may attain a degree of mobility which it never before possessed, and batteries would be enabled to act without restriction or hindrance on all occasions, whether placed with cavalry or infantry, and if abandoned to their own resources in action by their supports, which has happened before now, they would have some chance of escape left from being cut to pieces, while in retreat, by an enemy's cavalry, not to speak of the blessing it would be to the gunners in preserving their health, strength, and consequent efficiency for the trying moment they are called upon to open fire.

If by making the foregoing observations it has been shewn that field-batteries are not at present up to the work they may be called upon to perform, we think there is then good reason that some suggestion should be adopted to meet the difficulty; we therefore think the present not a wild one, and make no apology in offering it for want of better, as there can be no doubt of its advantage in the main.

The further consideration and construction of this carriage might confidently be intrusted to the able head of the carriage department, and we have no fear of the result.

This object is attained by the addition of twenty-four more horses to each field battery, when a force is obtained superior to any troop of horse-artillery, and equal to any difficulty that may arise. For if we gain by these means a battery which can at any moment increase its speed as circumstances require it, then the maintenance of a corps of horse artillery (at least such as is at present known by that name) becomes no longer necessary; and if so, the sooner the name is blotted out from the muster-roll of the regiment, the sooner will end all strife, malice, and favouritism in the corps, together with useless expense to the nation at large. Fondly do we hope the day may come when those feelings which we have alluded to no longer may exist, whatever may be the cause by which it is brought about, when the whole of the artillery will rise triumphantly above such petty influences, which have long been a detriment to the whole body, and a bar to their onward progress.

It will no doubt be said, in opposition to this plan, that the addition of six carriages to a field battery necessarily increases its bulk and consequent unwieldiness. To this might be said, that of the many carriages, carts, and various vehicles which accompany a field battery, none could be of more importance than those for the conveyance of the gun detachments; and it would be well here to state the number and nature of these carriages, &c., viz., eleven ammunition-wagons, one store limber-wagon, one spare gun-carriage, one forge, one rocket-carriage, one store-cart, one medicine-cart, two forage-wagons, three water-carts—total twenty-eight carriages, including the guns. Surely if for the above cause the addition of six more carriages is objected to, the striking out of six from the numerous list here given (many of which have been used for questionable purposes), and placing in their stead the carriages proposed, could be done without any material injury to the service, in comparison with the present want of conveyance for the detachments: we must seek for another cause against it before it can be pronounced infeasible. Many will doubtless be brought up, the merits of which we will not presume to judge. But we fear that the real cause against any improvement to field-batteries will not show itself boldly forth; for it has always tended to the same end, the prevention of any interference with the horse brigade, and thereby the loss of prestige to that corps, which could not be contemplated for a moment.

Some believe that a troop of horse-artillery is in a great measure independent of cavalry as a support, from the fact of having mounted gun detachments; and the great argument of such is that these will be able, by means of forming in front of their guns, to mask them from the sight of the enemy; and in this attitude they are also taught to charge. The applicability of this is denied; for if the enemy did not by means of a good reconnoitring telescope find the matter out, surely good sense must make us give credit to the opposing general for having his wits about him, and of determining the fact, that a mere handful of men, playing the part of cavalry, would not be drawn up, still less charge, for any other purpose than that of endeavouring to conceal their guns; and a smile might be imagined on the face of that general on viewing the attempt, and who might easily resolve any doubt of the matter by a well directed rocket, which would probably cause the horses of "the thin *blue* line" to waver in such a manner as to expose the deception.

The system is also to be condemned for exposing a double object to an enemy's fire, thereby causing the loss of the very men who work the guns. It is therefore evident that horse-artillery cannot properly be so employed; for it is only a deception of ourselves to try, in *that way*, to deceive an enemy.

Another point also shows itself in this matter, and is this, that the worst application that can be made of the powers of a horse, is that of placing the load on his back; for the same animal will draw with speed and ease more than double the quantity, even taking into consideration the present rigidity of the carriages used by the artillery, but which might be in a measure improved upon in the construction of a conveyance for the detachments. A troop of horse artillery requires ten horses per gun (for medium pieces)—*more than the field batteries* for their detachments. Three are generally employed to mount the horse holders, who take in charge the horses of the remaining gunners, when the latter rush to serve the gun. And there are circumstances under which this horse-holding would become a very doubtful matter, namely, in such a country as India, where the horses remain stallions, and the pugnacious qualities of two or three of such animals would render an exceedingly difficult task to one man to control.

It is also a matter for doubt that men will dismount from horses and mount again in the same time that it would take an equal number of men to dismount and mount again upon a carriage which could be made with a view of affording them every facility for doing so. If men can be got to mount the horses quicker, then we say that it must take a prodigious quantity of training to effect it, and that not unworthy of the brightest days of Astley's. But how far it is requisite in soldiers (who are sometimes made upon the shortest notice) remains to be proved more satisfactorily than has yet been done.

England now possesses eight troops of horse-artillery, and were the sixty horses (already spoken of) which are allowed for the gunners, taken from each troop and given to the field batteries, enough would be obtained to equip twenty such batteries as we have described, mounting one hundred and twenty guns, in place of the forty-eight already carried by the horse-artillery. But this is not all the saving effected, for if carried out there could no longer be any excuse for a different rate of pay throughout the regiment, and the dress of the men would not amount to nearly the same sum.

Whatever may be the merits of the foregoing lines (if any), we think that a plan which offers the equipment of one hundred and twenty guns in place of forty-eight, is at least worthy of consideration, and as such it looks for impartial judging. But we do not deceive ourselves by thinking it will be given. For were it only a blow struck at the customs of our forefathers, and which on all occasions are deemed the best examples to follow, it is enough to condemn it. There is another cause, and one of deeper import still, the fear of interference with the horse brigade. We should hardly mention it, as the subject is already worn threadbare; but still the darlings of interest and favouritism must be kept up, and we would hope, if so, that it may not be as a detriment to the remaining portion of the regiment. We have done; and in giving these remarks for publication, it is as well to state that credit is not taken for the introduction of new matter, but which, though perhaps known to some, the majority are unacquainted with; and these lines are written with the hope of awakening the subject; and if, by any observation here to be found, fuel may be added to the fire to light the wandering artillerist on the path of duty, it will be felt that these remarks have not been penned in vain.*

Field Artillery.

To the Editor of the United Service Magazine.

Sir,—Agreeing as I do with the generality of your remarks on field artillery, which appeared in your last number, I would wish to put forward a few observations which occur to me.

Field artillery, when acting with infantry, should not impede the movements of a single battalion, either in advancing, retiring, deploying, taking ground to a flank, &c.; but in its present hampered state, as clearly shown by you, how can this be depended on? Taking the case of a 9-pounder field battery; how can an officer in command, with the most perfect knowledge of his own duties, as well as the movements of infantry, get his guns clear of the front or flank of a column or line of infantry, in the event of a sudden movement, or change of position, so as not to impede their movements, and probably cause confusion, if he can only move at the same pace! If he trots, guns and gunners must become separated; and instead of the latter (loaded as they are in complete marching order), arriving fresh with their guns at the new position, when they do reach them again they are breathless. The late war in the Crimea has given but little opportunity of practical experience; no change of tactics in field movements of importance having taken place during any of those battles, save one incident, to which reference will be made.

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* Colburn's United Service Magazine for November 1857.

On the line of march, the evil of the present system is equally as apparent. Men, who have just come off a march in marching order, and who have, also, probably, been engaged in extricating the wheels of gun carriages, ammunition waggons &c., at various points along the line—from ditches, irregularities of surface, morasses, or any other obstructions—such men cannot, after the performance of great bodily exertions, be expected to be capable of foraging, watering, driving pickets, &c., for their horses, on arriving at the encamping ground. These facts show at once the absurdity of a field artillery-man having to carry his own kit and equipments complete, and yet to be supposed to be always at the proper spot, and prepared to serve his guns.

As an instance of the necessity of field artillery men having the means at hand of accompanying their guns, when they are compelled to move at a quick pace, we may be reminded of a circumstance which took place at the Battle of Alma, when a powerful column of Russians, some thousand strong, were advancing against a weak portion of our line. Two guns were ordered to advance to a position, and open fire on the enemy: away dashed the guns, and soon reached the spot. But where were the gunners? Doubtless, they followed as fast as their legs would permit them. The officers of artillery who accompanied these guns, including some of the staff who had brought the order, had to dismount and perform the duties of the gunners—spunging, loading, &c. The result is known: the column, after being torn through by a few rounds of shot, turned; so much more in proof of the necessity of a change from the present system, notwithstanding the ideas which a few individuals have so long been immoveable from.

This instance of the advantage, as well as absolute necessity of the mobility of field gunners, cannot be cited as a peculiar or an extraordinary case; such is likely to occur in any engagement. An artillery officer invariably looks to posessing a good position; a few minutes sooner or later in bringing a field battery to the desired position may change the fortune of the day. Horse artillery (that is, as generally understood by the present term) cannot be "ubiquitous," ready to dart forward from every point of the line, where need for a rapid advance, at a particular moment, may be required; it may be with cavalry on a flank, or it may be in reserve some distance in the rear. Thus, the ordinary field artillery will only be at the disposal of a general officer, for any sudden movement; which, by the present system, cannot respond to the call for a movement at an accelerated pace.

As to the final method to be determined on, to enable the gunners of a field battery to move at the same pace as their guns; that cannot occasion any difficulty—"where there is a will there is a way." A committee of officers, assembled by His Royal Highness, the General Commanding-in-Chief (than whom no individual takes a greater interest in the efficiency of the regiment), would soon determine the most advantageous method.

The proposition of a light car or carriage for the conveyance of a gun detachment, relieving the detachment at the same time of their knapsacks, &c., appears quite feasible; and, doubtless, a field battery with such would derive a great advantage, and be enabled to arrive at a high point of efficiency. These carriages could, also, be made available to carry a portion of the stores, &c., at present carried by the forage waggons, store carts, store limber waggons; in fact, a portion of all those stores which would not cause additional risk when exposed to the fire of an enemy during an engagement. Their total weight, when fully loaded, should enable them, with the number of horses proposed, viz., four, to move at the same pace as the gun carriage and limber. Thus their total amount might exceed considerably more than half the weight of the latter; as with teams of horses, those furthest from the carriage cannot draw so much as those nearer. Taking the weight of the 9-pounder gun, carriage, and limber, with side arms, ammunition, including two numbers of the gun detachment, with their arms, accoutrements, knapsacks, &c., we have a weight of about 43 cwt., for which eight horses are allowed; this would allow about 30 cwt. for the weight of the carriage, to be drawn by four horses, when packed complete, including the numbers of the gun detachment (hitherto supposed to be carried on the ammunition waggon.) Taking the weight of the latter, with their arms, accoutrements, knapsacks, &c., at 12 cwt., and the weight of the carriage at about 7 or 8 cwt., we shall be enabled to carry about 10 or 11 cwt. of stores on each of these carriages, or altogether between 60 and 70 cwt. of stores, &c., which are now distributed amongst the many vehicles attached to a battery.

Another method for increasing the mobility of gunners is such as is adopted in one of the presidencies in India, and which is, by mounting a gunner on each of the off horses attached to the gun. This system, it is affirmed, and it has been many years in existence, affords all the requisite celerity of movement required from horse artillery. To apply it to the present field battery system would require, at least, one-half of the gunners attached to a field battery, exclusive of the drivers, to be good horsemen; the practicability of which, under the present combined system of field and garrison artillery, would have to be considered. With a 9-pounder gun, four gunners would be mounted on the four off horses, and two gunners on the gun limber, as in the horse artillery, leaving still, at least, two more to be provided for.

I would, also, advocate the advisability of each gunner being armed with his carbine, in addition to his sword; the two together become a formidable weapon, the latter, by itself, useless. The rifled carbine, now in use, is light to carry, and would not impede the working of field guns, or be an encumbrance on the march. A field battery would not, then, feel itself so dependent on the support of infantry or cavalry, if on a flank or in an exposed position. In the event of being suddenly charged, they could resort to the use of their carbines with fixed swords—in fact, transform themselves into infantry; and, by each detachment rallying round its own gun, be enabled to drive off cavalry.*

I am, your most obedient servant,

Novemler 21st 1857. S

Remarks relative to the mobility and concentration of Field Artillery.

"Valeat quantum valere potest.
In hoc signo vinces."

It has been our province, on a former occasion, to endeavour to show the importance of a properly organized Field Artillery; and such a force stands forth as an undeniable necessity to a nation such as England, in which the elements of the standing army are kept within such narrow limits in time of peace, and the difficulty that exists during war of bringing that army to the proper strength from voluntary enlistment.

That policy is to be condemned which has hitherto looked upon military acquirements and study as unnecessary to any useful extent. And the utter contempt of the efforts which would endeavour to point out *war* as a science requiring great skill of combination and forethought, such as fall to the lot of few entirely to possess, but which in all may be cultivated in the direct proportion of the ability of each candidate,—We would also add the system which entirely ignores the usefulness of our scientific arms of the service, by steadily refusing to place any Officer of those arms in command of mixed portions of our service, in which Cavalry, Artillery, and Infantry, are supposed to be associated, and for which purpose all their qualifications best suit them ; of course *not* to the exclusion of others, far from it, for it is not from education alone that soldiers spring. But where the supply from natural talents fail us in what we want, surely the best substitute is found amongst those who have been obliged to make the art of war a study from their boyhood.

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* Colburn's United Service Magazine, January 1858.

This question has been often mooted before, and by those in high position and authority, but without any useful result. Some individuals have arisen to prove, that it would be a great mistake to employ scientific Officers in this way, and have used arguments in proof of their assertions, which may well draw forth a *smile* from any honest man, either military or civil. Be this as it may, we have but to go and look at the good effects which have arisen in foreign armies, and even in that of our East India Company, in which Officers of the scientific arms, are not prevented from commanding forces in the field :—that such is not the case in the royal army of England it is needless to state : for we rather trust in the obstinate courage and constancy of our troops, to overcome every obstacle, rather than use the wiles and stratagems of war, which are given to us as matters of history, both of ancient and modern times. That great exceptions to the application of this statement have risen up in England's need, possessed of all the brilliant qualities, which could adorn the soldier, none can contradict, familiar with the histories of Marlborough, Wellington, and Napier. But they are the *exceptions*, not the rule; and they, too, have passed away from us, and their great, and glorious talents, lost for ever; but still live in the memory of a grateful country, to whom, at least, if nothing else remains, they have left their experience in some measure to guide them.

Viewing these statements just made, it seems requisite that every available means should be taken advantage of, to place the nation possessing so small an army in comparison with other contemporary powers, on equal footing with them, without materially increasing our numbers; for where physical force fails us, we can draw upon our resources in mechanical science, and give our army the advantage of its help.

One of the greatest modern masters of the art of war,—Napoleon—gave it as a rule, that when his armies were weak, either in numbers or organization, that the deficiency should be supplied by a large and powerful artillery. Critics may observe, that he was originally an artillery officer, and consequently, had an inordinate idea of the power of that arm —and may, doubtless, assign similar opinions to any member of that profession, who would endeavour to point out its applicability. Be this as it may, for it is useless to speculate on it, few will give credit for disinterestedness to those who advocate a cause in which they themselves are concerned; but in the case of Napoleon, if he made this rule, he proved it, and that effectually, in many of his most decisive battles; for what other evidence is necessary, when we look back upon his great actions of Borodino, Wagram, Dresden, &c., &c.? in which, by means of an overwhelming fire, he kept the greater part of his enemy's line of battle in check; while with his other forces, he overturned in detail the remainder.

This rule seemed to be throughout one of the leading principles of Napoleon's tactics; and which he practised, perhaps, much more than had ever been thought of before, and with him seemed more in demand, as the experience of years increased. Since his time, others have advocated the same principle, with even greater force: and particularly in Russia, where the idea has gained much ground: in which Field-Marshal Prince of Warsaw, seems to have taken a leading part; and whose opinions are ably given by the Russian General o'kounieff, in a short treatise on modern tactics,* and which cannot be too warmly recommended to the perusal of those interested in military study.

In this work, General Okounieff has endeavoured to show the possibility of accomplishing, with every hope of success, what was before believed by former tacticians to be only admissible under very peculiar circumstances—namely, the attack on the centre of the enemy's line of battle; and he goes still further in stating, that those who tried and failed to accomplish it, must attribute their want of a decisive result to their not having carried out fully the plan which he recommends, and it is this: the concentration of fire from a large mass of field artillery—brought to bear upon the enemy's centre, at as short a range as possible, say about four hundred yards. By means of this murderous fire, the centre is supposed to be dissolved into a thing that was (and no doubt under most circumstances it would be), and columns of attack, composed of the three arms, are intended to take possession of the vacant point.

The remainder is simple enough, even to the mildest tactician; namely, to follow up the effect gained by dividing the enemy, to cut off his communications, attack him in reverse, and to overwhelm the separated portions in detail, by the mass of your own troops.

The effects gained by this system of attack may seem, on first sight, to be every thing desirable; but consideration will show that, like most arguments, there is more than one side to it, and in reflecting on their merits we naturally ask, from whence does he draw conclusions of the applicability of his plan? He candidly avows, that before the siege of Warsaw, in 1813, his ideas on the subject were very different as regards the employment of artillery. But that the overpowering effect which was produced by the concentration of fire from three hundred guns, which the Russians brought to bear upon the opposing artillery, so much so that the Polish fire was entirely extinguished; and with it we may add one of the last efforts of a people fighting for national liberty.

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* Translated into English by Captain W. H. Weaver and Lieut. E. M. Jones, H. M. 86th Regt. Printed and published by W. Clowes and Sons, 14, Charing Cross, London.

That he should conclude from the effects here described, in the case of Warsaw, that the attack on the centre may be successfully pursued under all other circumstances, his warmest admirers will scarcely contend, and must admit that from, perhaps, a feeling of enthusiasm in his subject, caused from beholding a great result in one case, that upon this he wishes to lead us to think that the same effect must arise from the use of artillery directed upon a central point, to which he would confine their attention almost entirely; and this from what he saw at Warsaw—a *siege*. Without disparaging his work in the least for the great principle, the " ne plus ultra" of modern tactics, he has hit upon decidedly; but we fear he has taken a narrow view of the subject: for he must give his enemy some credit for the knowledge of his profession, and we should suppose, that if he contends, that the attack on the centre (according to his plan) is the great stroke of tactical action, that his enemy on becoming aware of his intention, may thwart it by the disposition of his line of battle, in such a manner that the attack on the centre, which he advocates, must of necessity fail; and that furthermore, the tables might be turned on himself. For if a general devotes his thoughts and means of attack upon one central point, he must most probably leave his own position in some places weakly defended, and, consequently, his enemy, having disposed his line of battle in such a manner as to guard his centre from this overpowering fire, may safely attempt an attack with his own forces on the weak part of his adversary.

General Jomini gives us his opinion* upon the subject of general Okounieff's plan of confining his attention to a central attack: which, though very short, is clear and concise to a great degree; which are qualities that have distinguished that accomplished and scientific soldier, for whose opinion all must have a deep respect from the abilities which he has so brilliantly shown in the many military works which have emanated from his talented pen—the worth of which may be judged by the great value placed upon them by those who look upon the cultivation of the military art as something more to the defence of a nation than the finest raw materials of which armies can boast. The opinion of the great Napoleon himself is enough to crown him with imperishable fame, when he deems that the purchase of his work (" Traite des grandes Operations Militaires") at what seems an almost fabulous value for pen, ink, and paper, would be cheap, when he robbed his adversaries of its benefit. Notwithstanding General Jomini's opinion on the subject matter of Oukounieff's system of attack on the centre, with regard to its effects under varied circumstances, he has still given much praise to a plan which, when properly viewed, gives such a variety of resources to be taken advantage of, according to circumstances, and it is to be regretted that General Oukounieff confined himself to such narrow limits; but should have boldly brought forward his principle, to act under less restriction—whether it be the attack on centre or flank, or in whatever manner the fire of his powerful batteries might best be brought into play, according to the most careful disposition which the tactical art will allow under varied circumstances, when opposed to an enemy, who, he must suppose, will make combinations of defence or attack of the greatest value. Had he done this, he would truly have opened up a subject of deep interest and inquiry in modern tactics. He has, however, pointed out the way, which, if followed up, will lead to results, which, it is we think not saying too much, will startle those who have been in the habit of looking upon artillery as a convenient help now and then to be employed as the whim of the moment directs, and for which there is no need of consideration; for if the artillery are not at hand, "*we'll do this business, boys, with the could iron*," as Picton said to the Rangers of Connaught upon the attack on Ciudad Rodrigo, and which was most appropriate upon THAT occasion. It is not for us, however, to touch upon details in such a paper as this on which our worthy Editor necessarily puts a limit; but we would invite other pens more talented than our's to take the subject up and join experience, if possible, with a thorough knowledge of the art of war, and give to the country a work which may prove a safeguard, if acted upon, in the hour of need.—

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* In his " Precis de l'Art de la Guerre," chapter viii., art. 46, on " Formation et emploi de l'Artillerie," we forbear to quote that there may be no excuse against reading that excellent book.

The great gist of the argument that might be used should be, that the concentrated fire of a large mass of artillery directed upon a point, wherever it may be, must, under ordinary circumstances, cause the annihilation of that point, and the consequent ability of an army to take possession of it, with a view of following up their success. And for the practical application of this idea, our field-artillery must be better organized—accustomed to move with *rapidity* and *precision* in masses of brigades: for without mobility, any plan which advocates decisive results from artillery employed on a large scale, will fail. And let there be always a support for artillery, consisting of light infantry for ordinary field-batteries and light cavalry, armed with good rifles—real light cavalry, in every acceptation of the word; these should be attached to the light field-batteries, or what are now somewhat similar in their intentions, under the grandiloquent name of Horse Artillery.

In speaking of these supports, it is as well to warn against the employment of a certain number of marksmen, to be attached to each gun detachment: which is, at present, under consideration on the Continent. But such an addition must ever prove a clog upon the proper movements of artillery. *No;* let there be legitimate and separate supports, whose business it will be, to help the guns upon all occasions; and, moreover, commanded by some one, *if not* an artillery officer, at least by some other officer who knows how to handle troops under such circumstances; and who will not see batteries wandering over the field, in search of adventure wherever it can be found, without any support; that this has happened before now, it is useless to remind the reader.

The thoughts of Napoleon upon the employment of field artillery, seemed much to incline towards *massing* its fire; but although in his most prominent employment of artillery, in action, there can be traced a certain hesitation, as if he doubted the result—from what cause we will not take upon ourselves to judge. And even at Wagram, where he concentrated the fire of one hundred guns upon the Austrian army, the effects of which do not seem to have answered his first expectations. The reason would seem in the fact of not having followed up with his artillery the success of his opening fire. History does not seem to particularize so clearly upon this event that we might assign a cause for the discrepancy. But did it arise in this, our day, we think it might safely be laid on the present want of mobility to the mass of our field artillery. That some cause of this nature prevented Napoleon from reaping the full benefit of his dispositions, may safely be argued; the more so, as it accounts for the want of success in the measures of so great a man, who can hardly be accused, even by the most confident, of any want of knowledge pertaining to the art of war. His evidence, however, in favor of the employment of artillery in action is scarcely ever so forcibly shown as in one of his letters to Prince Eugene, while that General was engaged in Italy in 1813, in which he writes, " You must not leave the Adige without a grand battle. Grand battles are gained by artillery.

Have an abundance, 12-pounders."—*Memoirs of Marshal Marmont.*

But from this should not be taken the idea that 12-pounders are to be supposed the only gun for field purposes; for although that gun may be employed with advantage, as a gun of position or reserve, which for decisive moments, may most advantageously be moved to the point of greatest importance, yet, for the purpose of general action, and the armament of the greater part of our field batteries, a gun of the calibre and weight of our 9-pounder, seems most appropriate; of course, there is a lighter gun, the 6-pounder, which must not be wholly condemned, for its services are important, and may be said to act in respect to the rest of the force, "en tirailleur," if such an expression can be used in speaking of artillery. A good deal has been said of late with regard to increasing the usual calibre of our field guns, and which, to a small extent, was done during the Crimean war. Much care and consideration, however, must be used in this, to take precaution that the matter does not run away with us bodily, in the cravings for projectiles of larger dimensions, than have been hitherto most commonly used; for, although the employment of heay guns in the field, may be requisite under certain circumstances; and that, consequently, an army should not be without a quota of them; for which purpose some means might be used towards lightening such a gun as our 18-pounder, by using gun-metal instead of iron, in its construction, and making it more available. The same might be said with regard to its accompanying 8-inch howitzer, but the desirableness of a heavier gun should never cause us to hamper an army in the field with too many of them: for it must ever be borne in mind, that, as in most mechanical contrivances, what we gain in power we lose in time; or in this case, what we gain in the *power* of range is lost in the increase (in a much greater ratio) of our want of mobility, and consequent slowness. And that this great addition of range is so necessary to field artillery, is a matter which admits of doubt, notwithstanding what has been urged with regard to the augmenting power of small arms, and the necessity of artillery having a larger power of range, in order to overbalance this rifle practice; but those who have urged this question appear to forget that it seldom falls to the lot of an army when having taken up its intended line of battle, finds itself so far from the enemy, or in ground of such unbroken and even extent, that the range of our present field-guns are not more than sufficient to reach them with precision and effect. And they should remember, if there is no limit to the accuracy of their rifles, that there is a limit to the power of *optics* which Providence has given us, were not this enough, it may be said that the smoke, noise, and excitement of the field of battle, will soon place the precision of small-arms in quite another light; for the successful fire of the rifle is one thing in action, in which the bearer has to contend against these disadvantages, and also the belief that his adversary has the same unkind intention towards him. This, we say, is one thing for which the beautiful accuracy of the Hythe practice ground, offers no criterion of success.

That the improvements in small-arms should cause the destruction of artillery to the extent by some imagined is, we think, a groundless argument. But that this progress will effect a slight change in tactics, we are free to confess: for it seems to show the increased necessity for the employment of light troops of all arms, and that a great superiority will arise to a nation possessing a large force of this nature. The working of this idea shows itself now in Russia—a country which has always done its best to profit by experience, and has now demonstrated that fact since the last war, by adding to the number of their light troops to such an extent, that when we compare our own paucity in that arm, we have ample cause to wonder whether such a vast augmentation is necessary.

But, nevertheless, the great principles of tactical warfare can scarcely alter; and we would hope that changes of ideas with regard to the employment of light infantry, with a view to bring forward the qualities of the Enfield-rifle, may never lead us to forget the most important part of the story, the British bayonet; for with all the additions that science and enlightenment may add to the art of war, still with us in that point, at least, we must not forget our antecedents, but ever remember that with hand to hand in deadly strife, the administration of cold steel in the impetuous charge, joined with the thrilling "British cheer" has ever sounded in the ears of our enemies as the death-knell of their hope of success. But it is not always, it must be allowed, that this hand-to-hand conflict can be brought about, and this demands further attention; for although the serried ranks of our matchless infantry may stand calm and coolly, conscious of their courage, under almost wondrous difficulty, yet, what can that avail against the iron nail which can be brought to bear against them—which even the resistance of an adamantine rock could not withstand; surely, an idea which offers to prevent the annihilation of such unequalled troops should be sought, and may we think safely be found in the fact, that to reply to the fire which causes this destruction, we must bring forward guns to a larger extent than those opposed to us, and overwhelm with our fire that of theirs; and the propriety of protecting good infantry cannot be better advocated, than by giving one of Napoleon's maxims*, viz. "The *better* the infantry is, the *more* necessary and expedient it is to protect and support it by very powerful "artillery. Good infantry is, doubtless, the sinew of an "army; but if the *very best* infantry have to fight for any "length of time, and support several encounters against an "enemy very superior in artillery, it will lose its courage, "and be ruined. It may be that a general very skilful in "manœuvring, more able than his adversary, and possessing "better infantry, will obtain successes during a *part* of a "campaign, notwithstanding that his artillery is very in-

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* Quoted from "Yates's Principles of Tactics."

"ferior; but on the day of a decisive general action, he will "feel most cruelly his inferiority in artillery." This must go a good way to prove our assertions. Though we must say here, that although the principle of directing the fire of artillery on artillery is here advocated, yet it by no means follows that it should be acted upon at all times as a rule which should stand immutable under every circumstance—no; for the fire of artillery against infantry must always remain, according to the usual acceptation of maxims on that head; but in the employment of artillery *versus* artillery, we rather speak of it as a large force of that arm to be held in reserve for such occasions, and to be brought to bear upon any point which may be found desirable; the remainder of the field artillery would be appropriately used in carrying out the rules, that we speak of, as common and generally received on the subject.

To enter on this matter, and say that the concentration of artillery-fire alone is sufficient to overcome any difficulty we should, indeed, commit a grievous error; *no*: there is wanting something more important still; and that we find in the word MOBILITY, and in the use of which, we may be accused of tautology; but, nevertheless, it is necessary to repeat again and again, for in *it* lies one of the true sources of success to concentrated artillery. It is a common rule of war to say that upon the vigour and rapidity with which movements, both of attack and defence are made, mainly depend their favourable issue. This principle applies particularly to the object in view; for, in the case of our concentrated fire, and and the quickness with which it is brought to bear, mainly depend its hope of succeeding in its object.

In this, matters of history strongly bear us out; and we may state, had Soult at Albuera, that bloody field for which we take to ourselves a victory, but to which the language of a General, upon a like occasion, we may apply, "a few more such victories, and I'm undone"—had Soult quickly advanced the French Artillery to follow up their first success, and which they afterwards slowly tried when too late; had they done this, we maintain that a different result would have been the consequence, and that small band of 1800 British heroes, out of 9000, would not have existed to tell how this somewhat doubtful victory was fought and won. Other examples can be adduced, but we deem it useless to encumber these lines with too much extracted matter, and which is better learned by the consideration of the *pros* and *cons* of military history; sufficient be it for us to confine ourselves to the reasoning why this has occurred, and which is answered in saying, that at the periods to which we allude, the construction of military carriages was such that little rapidity could be obtained from them. We cannot better explain this than by giving, in his own words, the description of the gun carriages of those times, which we have gathered from the work of a distinguished Officer of artillery. They were "drawn by horses in single file, driven by a civilian "on foot, wielding a carter's whip; the carriage of the gun "receiving its direction from a trail-truck, traversed by a "handspike."* Things have been IMPROVING since those times, though there is still work to be done. But it is not in the gun-carriage that with us now the want of mobility lies; it is the plan which systematically prevents the gunner of the British field-batteries from the proper use of the strength and endurance which the Almighty has given him for useful purposes; and it cannot be denied that the carrying of the knapsack by them will not cause this: although it is a rule of long continuance in armies to state that the kit of the soldier should never be separated from him, yet, in field artillery matters, this does not hold good, for there are means of carrying it without incapacitating the gunner; for if it is advanced that the knapsacks cannot be carried on the ammunition waggons, surely the many other carriages attached to a battery could lend a helping hand to do it; and if that is found impracticable, a particular conveyance for the purpose, might, without injury to the service, be assigned.*

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* **Taken from Sir Robert Gardiner, K. C. B., K. C. H., General, R. A., in his work on artillery, lately published, in which the gallant Officer has taken a clear and enlightened view of his subject. It is to be regretted that his contemporaries do not take the same idea, though it is not to be wondered at, when, in their youth, they saw our father's plan of *Mobility* why should we be astonished if they think we are getting too fast?**

Swiss Rifles and Rifle Practice.

Who that has travelled in Switzerland does not remember meeting parties of young men in steamboat, *char-a-banc*, or afoot, journeying in company, singing choruses, drinking wine and beer on every possible occasion, their rifles slung on their backs or laid carefully beside them, their hats bedizened with coloured bits of card, like the man at Brighton who sells the coloured papers which may be turned into almost anything, inclusive of money it must be supposed, and of which he wears one specimen as a hat,—who, we repeat, of the travelled many does not know them? These are the shooters at the cantonal or federal shooting matches, and the coloured papers worn so flauntingly in their hats are the certificates of the hits they have made. Their rifles are heavy—wofully heavy—thick metal and small bore, of American pattern—what we should call pea-rifles nearly. They are preposterous looking weapons; they look as if the gun maker had conceived the idea in a nightmare and executed it in a frenzy. They generally weigh about 18 lbs. English. They have hair triggers, which are so fine that it requires little more than a thought to fire them; and the tyro, however much he may be warned, invariably finds the piece go off long before he has had the remotest idea of taking aim. Let us try and describe one. First, the barrel is generally octagonal, and averages some two-and-thirty inches in length. The thickness of metal is very great, as we have said—" in the clear," from exterior to exterior, it is perhaps one inch or one inch and a quarter and in the centre is the bore of little more than a quarter of an inch in diameter. In fact, it is an octagonal bar of metal with a small hole drilled in it, and afterwards rifled. The sight is the American telescope sight. The muzzle sight is composed of a "bead" about one-twentieth of an inch in diameter standing on an upright shank. This arrangement is protected from injury by a cylindrical penthouse. It is let into the barrel by chipping up the metal of the latter, and may be moved horizontally to the right or left by a smart tap. The breech sight is composed of a tube or telescope mounted on a shank fitting into a metal-lined hole in the stock, and capable of being fastened by a thumb-screw at any given elevation, which may be read off on the graduations of the shank. The connection between the shank and the telescope sight is such that, by means of a screw, the telescope likewise is capable of being moved horizontally to the right and left. Thus on a windy day, with the wind blowing right across the range, a small motion is given to the breech sight to allow for the deflection thus caused. The telescope is merely a tube which may be unscrewed in the centre, having a disk on the side next the eye. Diaphragms of various apertures may be placed in the telescope. The opening is usually not larger than the one-fortieth part of an inch. The butt of the stock is curved (the better to fit the hollow of the shoulder) into the shape of the letter C, one point of which goes under the armpit. This, it is said, has the effect of steadying the rifle. But to hold such a piece of artillery really steady requires further arrangements. The marksman stands upright, with his feet separated, the left hip thrust forward, and the left elbow resting thereon. This position is admirable, but unfortunately his forearm is too short, by some four inches, to reach the stock of the rifle when it is held horizontally. To obviate this a wooden handle, shaped according to fancy is fastened to the stock, and sometimes the lower side of it is stuffed like a chair cushion. This gives the weapon a ridiculously cumbrous look. But when it is considered that these rifles are only intended for shooting matches, their handiness or the reverse is of trifling importance. So much for the weapon.

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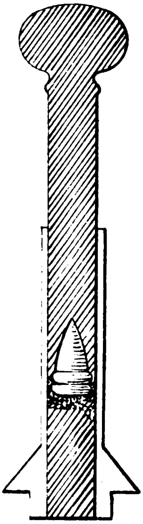
* Colburn's United Service Magazine, January 1858.

At that loveliest of all spots in the loveliest of all countries Interlaken—just below the hotels on the road leading to the lake of Brienz, is an open, solidly-built shed, the property of the commune. This is the shooting-shed. The range is across the Aare; an upright crag on the opposite bank forming the butt. The distance is short, it is true, but the shooting is proportionately accurate, as we shall see. .On a saturday afternoon various tradesmen of the villages of Interlaken and Unterseen will be usually found assembled here. The apothecary of the village lays by his pestle and mortar, which he is wont to exercise, let us hope, to the saving of the lives of his fellow villagers, to practice an art of which the object is in a diametrically opposite direction, with reference to the lives of the enemies of his country. The village gunsmith, Rieder by name, who, by the way, can turn out admirable weapons, throws aside his file and banks up the fire of his forge to join the shooting party at the shed; and so I might go on through half the tradesmen of the village. Some have reputations to support, some to gain, as marksmen; but whatever the motive may be, they keep up a continuous fire from about 1 P. M. until dark on a long summer evening. The creature comforts are not forgotten: plates of cold meat, *choppes* of wine, &c., reanimate the failing strength of the marksmen.

Let us now enter the shed and watch proceedings. There are a number of men collected, perhaps a dozen or a dozen and a half; the village is not large, and it is only occasionally that some of the tradesmen attend, as many cannot get away from their employments during the summer months, such as hotel-keepers, &c. All round the shed runs a shelf at a convenient height, with cuts in it to receive the barrel of the rifle. On the shelf is all the apparatus connected with the loading department in neat tin boxes. Some of the men are loading, others firing. Let us inspect the process of loading. It seems to be, *de rigueur*, that those persons who, while engaged, in certain pursuits, one would suppose, ought especially to avoid cigar-smoking, invariably make a point of indulging in that pernicious practice against all reason. A billiard-player may be generally seen to smoke while stretching over the table to make a difficult "shot," the pale blue smoke curling gently upwards to the left eye, thereby totally incapacitating that organ from being of the slightest use, not to say the reverse. These rifle-shooters, too, always smoke, more particularly when loading. When "the party" is short-sighted, and carries the powder charge close to his nose, the more accurately to observe whether the charger is quite full, yet not too full, for they are scrupulous to even a few corns, it is a more exciting than an amusing sight to any bystander who has a proper respect for gunpowder. But, oddly enough, "blows up" are never heard of. Down then goes the powder. Let us look at the charger. It is a hollow cylinder of iron, having a piston working in it, the shaft of which is graduated, so that the charge may be altered infinitesimally. The shaft is fixed at any point by a screw in the side of the cylinder. The next operation is fitting a patch, for every one in Switzerland shoots with a patch. For this purpose the top of the barrel, which, let us say, is an inch in diameter, is countersunk for one-tenth of an inch in depth, by three-fourths of an inch in diameter. Into this the patch fits. Then a starter, of somewhat the shape of the figure in the margin (Fig. 1) having a bullet in it, is set home into the countersink, to which it is accurately adapted, and a blow is struck with the hand at the top of the handle. This insures the axis of the bullet coinciding with the axis of the piece. The bullet is then set home with the ramrod. In some instances the ramrod has a shoulder near the head, so placed that, in ramming down a bullet, the latter

Fig. 1



can never be put further home than within about one-tenth of an inch of the charge.

And now for a shot. The targets are two in number, each 3 feet 9 inches square, and having a bull's-eye of 13 inches in diameter. They are 200 yards off. The hair trigger is set, and the marksman, supporting the elbow on the hip, and taking aim without a rest fires: A man steps out from behind a large flagstone near the target, and, with a piece of blackened pasteboard at the end of a stick, points out the position of the hole made by the bullet. While he is thus engaged another of the marksmen is aiming, and fires at the neighbouring target, not more than three or four yards off from the former! The marksmen shoot for a pool of a trifling amount, just enough to make it interesting. One day that the writer of this paper was present he had notes kept of the shooting. They were as follows:—

Rifle Practice at Interlaken, 12th of July 1856.—Distance 550 Swiss feet, or 200 yards. Target 3 feet 9 inches square. Bull's-eye 13 inches in diameter. Bullet cylindro conical. Weight and charge various.

Names.	Rounds.	Bull's eye.	Hits in the Target not Bull's eyes.	Per centage of Bull's eyes.	Remarks.
1. Rieder	33	26	7	78·8	
2. Scherz	33	28	5	84·8	
3. Strasser	33	21	11	63·6	One bullet missed the Target altogether
4. Lichte	33	29	4	87·8	

One of these men put nineteen bullets successively into the bull's eye.* Now this must be considered admirable practice, considering that the men were not professional marksmen, but simply village tradesmen. When, further, it is considered that these shooting clubs exist in every part of Switzerland—that an enormous per-centage of the male population are in possession of rifles—indeed, that in no country in the world are there, in proportion to the population, so many marksmen and rifles—it will be obvious to the most careless observer the vast power this little country possesses to resist invasion.

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* The following practice in America will be interesting: it was made *from a rest*: "The practice in matches is recorded by what are called 'strings.' The distance from the centre spot to the centre of each shot-hole is measured and taken down as it is fired; and after the number of shots agreed upon has been fired, the whole of these are added together and called a "string" of so many inches.

"From 10 to 20 shots are the usual number fired, and 40 rods (220 yards) the most common distance. In the match at Fort Plain Mr. James made a 'string'

Such little shooting clubs as above described are the preparatory schools, as it were, for the marksmen who figure at the cantonal and federal shooting matches. In the canton of Berne, this year, the cantonal match took place at Thun. The writer, with a party of friends. had an opportunity of paying a hurried visit to the scene. It was quite a gay affair. People had come in from various directions. A band had been extemporised, and played away merrily. One of the bandsmen had carried the writer's bag over the Gemmi a few days previously. An hotel, decorated with flags and evergreens, was crammed with customers, dining, drinking,—respectably be it said—smoking, card-playing, talking, laughing, and enjoying themselves immensely. Just in front of the hotel, and close by the river, was the shooting-shed. There were some fifteen targets of the same size as those above mentioned, lettered A, B, C, &c., at a distance of 200 yards. The shed was divided into as many boxes as there were targets. When we reached the scene of operations there had been a cessation of firing for about an hour, to enable the persons engaged to dine. We were told that we should not have long to wait, however, for a recommencement of the proceedings. We had thus time to discover that the members of

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of 20 shots, which measured 32½ inches, or each shot rather over an inch and a half from the centre of the paper at 220 yards. This was considered a good string, as the weather was windy and unfavourable . . . . . In his workshop at Utica Mr. James showed Lieut. W——— a 'string' of 10 shots, fired at 220 yards, by his partner, Mr. Ferris, and measuring only 7¾ inches. This is supposed to be the best string on record, and was made with a telescope sight."—*Report on Machinery in the United States*, 1855.

the "bureau" were located upstairs, the shed having two stories; that at the foot of each target sat a marker, who in some mysterious manner was in communication with the bureau clerk upstairs aforesaid; that the marker, when a bullet struck in the interior circle of the bull's eye (some three inches in diameter), sent an account of the transaction, with the exact distance from the central point, to the clerk who again made an entry of it, and filled in a coloured ticket to be given to the shooter; that each shot costs so many centimes at A; at B, perhaps it costs twice as much, or half as much more, and so on, the prizes to be obtained varying proportionately. There were strings reaching from each pen of the shooting-shed to the marker at the target; and there were "lifts," in which slid up and down little open boxes, bringing in the tickets from the bureau to the shooter. Altogether, there was such an amount of mysterious effects as to create in us as much wonder and bewilderment as ever did the miraculous automatic cooking utensil which the "single gentleman" displayed before the admiring eyes of Mr. Dick Swiveller. The clearness of our perceptions, we may fairly say was not much increased when the shooting began. First, a small piece of artillery was fired within a few yards of us, and then from all the pens commenced a file firing, which would have done honor to a battalion of infantry. But this was not all. No sooner did one shot pierce the target than a circular piece of card made its appearance, marking the spot struck by the shot; then down went the target into the bowels of the earth, and up came another. If the bullet struck in the central ring of the bull's eye, three or four inches in diameter, out swung a huge number—a *2* or a *3*—representing, we imagined, the distance from the central spot. The number then disappeared and the firing continued much quicker than it takes us to describe it. We were told that at some shooting matches, to prevent the eye from being distracted by what is going on to the right and left, rows of little pine trees are planted, forming as many alleys as there are targets.

We were shown the federal government prize. It was a rifle of the pattern used by the Jägers (afterwards described) but nicely finished, with a silver plate and an inscription ready to receive the happy winner's name.

The above will give some idea of the way rifle-practice is pursued in Switzerland. It now remains for us to give some account of the military rifles in use, and of the experiments made on various arms, with a view to decide on a national weapon. We cannot do better than translate from an interesting German work, lately published, on rifled fire-arms, entitled "Das Gezogene-Infanterie Gewehr," by Captain Schön of the Saxon Infantry Bodyguard,—firstly, the account of the "Experiments on Small Arms in Switzerland," leading to the adoption of the present Jäger rifle, and afterwards a description of the military rifles now in use in that country under the head of the "The Swiss system."

EXPERIMENTS ON SMALL ARMS IN SWITZERLAND.

The Commission charged with making proposals for the amelioration of the Swiss rifle, carried on a series of experiments, in the year 1847, with twelve different rifles. The object was not only to reduce the calibre and weight of the arm, but more especially extended towards ascertaining the relative efficacy of the elongated and spherical bullets. The rifles selected for experiment were as follows:—1st, the Sardinian Bersaglieri (riflemen) rifle; 2nd, the French pillar-breech rifle (*carabine à tige*) of the year 1846; 3rd, the French wall piece; 4th, the French Chasseur rifle; 5th, Wild's rifle; 6th, a Prussian rifle; 7th, a rifle of a model made at Berne; 8th, one from Lucerne; 9th, one from Uri; 10th, one from Glarus; 11th, a pillar-breech rifle, by Lepage of Paris, and, 12th, a Berne rifle of the old model, having a pillar-breech.

The results obtained clearly demonstrated the great superiority of the pointed over the spherical bullets, with reference to accurate shooting and percussive force, more particularly at long distances; with only one half the charge the effect of the former was double that of the latter. In consequence of the successful results of these experiments the Commission decided upon reducing the weight of the arm, for which purpose they caused to be constructed two new rifles for firing pointed bullets, according to dimensions which they laid down. One had a pillar screw breech without a chamber, the other had a chamber, but no pillar. Further, with a view of introducing the cartridge instead of making use of a powder horn, and of retaining the wadding for the bullet, patches were adopted; as it was found that the pillar, when the bullet is set home with the rammer, does not "force" the lead of the bullet sufficiently, and in a manner to be depended upon, into the grooves, according to the intention of that instrument.

This Commission re-assembled in the year 1848, for further experiment, and to test the above-mentioned proposals, for which purpose they made use of the following rifles:—1st, the two rifles constructed in 1847 according to the views of the Commission: the calibre for the bullet of one twenty-fourth of a Swiss lb., or 320 English grains, was the same as that of the ordinary arm; 2nd, an American rifle with a bullet of one fifty-seventh of a Swiss lb., or 135 grains English; 3rd, an Austrian chambered rifle with a bullet of one-fifteenth of a Swiss lb., or 514 grains English; 4th, a rifle from Appenzell, being a modification of the American systems, carrying a bullet of one-sixtieth of a Swiss lb., or 128 grains English; 5th, a similar arm from Aargau, with a bullet of one forty-eighth of a Swiss lb., or 161 grains English; 6th, a rifle from Vaud, having a conical bullet with three rings, weighing one-thirty-first of a Swiss lb., or 249 grains English; 7th, the jäger rifle on Wild's system, as in use in Wurtemburg; and, 8th, as, during the course of the experiments, the Commission had convinced itself of the very little use of the American rifle, it was replaced by a rifle barrel, made after the commencement of the experi ments, of a smaller calibre than both the rifles mentioned under the first head; its bullet was conical, it had two grooves, and weighed one twenty-eighth of a Swiss lb., or 275 grains English.

In these, as well as in the former experiments, the accurate shooting of the pointed bullets, even with remarkably small calibres, was evident, the American rifle distinguishing itself particularly in this respect.

The Commission here made the important observation that the elongated bullet lost much less of its initial velocity than the spherical; consequently, that the trajectory curve was much flatter, and the bullet thus commanded a greater extent of ground. This fact certainly directly contradicts the results attained in the same year in Sweden from the experiments there carried on, in the report of which it is stated that the pointed bullets required greater elevation for the same distances as compared with the spherical, and, consequently, that the trajectory was far more curved, and the ground commanded would be far less.

The Commission abandoned the pillar to return to the previously proposed system of loading with a patch, as, in that case, the pillar would have less to contribute towards expanding the bullet into the grooves, because the latter is already fixed in the bore sufficiently tightly by means of the patch; and, as the other object to be affected by the pillar—namely, to hinder the bullet, in ramming home, from being pressed on to the powder—is to be attained with at least equal certainty by the usual shield on the ramrod of Wild's rifle, the latter recommended itself to the Commission for adoption.

At 400 Swiss paces, or 328 yards, all the rifles used in the experiments, with the exception of the Austrian chambered rifle, which was a little behind the rest, gave from 90 to 100 per cent. of hits in a target of 8' Swiss, or 7·9 ft., square English. At 600 paces, or 492 yards, from 70 to 100 hits per cent, Wild's rifle giving only 26 per cent. At 700 and 800 paces Swiss, or 574 and 656 yards, the rifles Nos. 1 and 8 and the American rifle still shot very well, at 900 Swiss paces or 738 yards, the hits had fallen to 50 per cent.

All the rifles carried pointed bullets, with the exception of Wild's and the Austrian chambered rifle.

The percussive force at 200 Swiss paces, or 164 yards, was tested by firing at sheet-iron, the Federal rifles under the heads 1 and 8 proving themselves superior, as their bullets pierced all the plates; while the effect of the American rifle was very small. At 400 and 500 Swiss paces or 328 and 410 yards English, firing at fir-wood targets, the effect of all the pointed bullets was still considerable: the above mentioned Federal rifles pierced three one-inch, or 1·182 English inch planks. The American rifles only pierced two similar planks; the spherical bullets were of no effect whatever. The bullets of an infantry musket, rifled for the purpose of these experiments, had no more percussive force at 200 Swiss paces, or 164 yards, than pointed bullets of a like weight fired with half the charge at 500 Swiss paces, or 410 yards.

In consequence of the successful results of the practice of the rifles numbered 1 and 8, the commission proposed to adopt the latter, with a bullet of one twenty-eighth of a Swiss lb., or 276 grains English, and that for this purpose a rifle of that model should be given to each canton for further experiments and practical use.

The many *pros* and *cons* resulted in the Commission being once more called together in the latter part of the autumn of 1849 at Berne, with a view of again testing that arm which it had proposed, as well as other models of rifles sent from various cantons.

These arms were; 1st, the proposed new Federal rifle No. 8, of the year 1848, bullets one twenty-ninth of a Swiss lb., or 276 grains English, part having one and part two rings; 2nd a rifle of a model from Zurich, bullet one 39th of a Swiss lb., or 198 grains English, with one ring; 3rd, a rifle of a model from Thurgau with a bullet of one forty-second of a Swiss lb., or 184 grains English and provided with a starter for loading; 4th, two rifles from Lucerne, one of which was almost exactly like the Federal rifle, but differing in the smaller inclination of the grooves (this small twist proved itself to be insufficient during the course of the experiments), the other was of a calibre between the Federal rifle and that from Zurich one revolution of the grooves would be made in 3′ 6″, Swiss, or 42·5 inches English. Three bullet-moulds for bullets of various lengths were presented with it, each having three rings. 5th, a rifle from Zug, with a bullet of one thirty-seventh of a Swiss lb., or 209 English grains, having three rings; 6th, three rifles from Colonel Brudner, two being of larger calibre and greater weight than the rifle he presented in 1848 as No. 4; the third had the calibre of the above-mentioned American Rifle, the twist of the grooves being one revolution in 3′ 2″, or 37·8 inches English; and, 7th, a rifle presented by Major Noblet, with a twist of one revolution in 6′ Swiss, or 70·9 English inches. This rifle was not tried continuously during the whole course of the experiment, as its bullet had too little rotation.

The Commission in the abovenamed year being prevented by the state of the weather from proceeding with the experiments it had commenced, was unable to resume its labours until March 1850. During this interval, Colonel Wurstemberger, the reporter to the Commission, occupied himself with the construction of suitable bullets, and, further, had made two rifles of the models 2 and 3, with a calibre of 3 lines 4·5 points Swiss, or 0·408 inch English. These bullets proved themselves in the subsequent experiments to be most admirable. The charge used with them was 4 grammes, or 2·26 drams: they were thirty to the Swiss lb., or 1·1 English lb. Finally, a new barrel, having a calibre of 3 lines 5 points Swiss, or 0·414 English grains, and a twist of groove of one revolution in 3′ Swiss, or 35·1 inches

English was made for the second Lucerne rifle under the head No. 4. This rifle, firing Wurstemberger's bullets, whose weight was 16·6 grammes, or 256 grains English, and the last named charge of 4 grammes, or 2·26 drams English, gave such extraordinary results that the Commission unanimously voted for the adoption of the new rifle, with the bullet and charge mentioned. In consequence of this recommendation, it was definitively accepted by the Military Department as the model for the new armament of the Federal riflemen.*

With reference to the probability of a hit, this model of 1850 gave the following results:—

Out of 100 Shots at

200 paces Swiss	= 164 yds.	in a target of	8′ Swiss square	= 7·9 ft. Eng.	100 hits.
„ „ ..	= „ ..	..	4′ ..	= 3·9 ..	100 „
„ „ ..	= „ ..	..	2′ ..	= 1·9 ..	100 „
400 „ ..	= 328 ..	..	8′ ..	= 7·9 ..	100 „
„ „ ..	= „ ..	..	4′ ..	= 3·9 ..	100 „
„ „ ..	= „ ..	..	2′ ..	= 1·9 ..	100 „
600 „ ..	= 492 ..	..	4′ wide × 6′ high	= 3·9 ft. × 5·9	97 „
„ „ ..	= „ ..	..	8′ Swiss high	= 7·9 ft. Eng.	100 „

The firing at both the last targets was in a high wind.

800 paces Swiss	= 656 yds.	in a target of	8′ Swiss square	= 7·9 ft. Eng.	100 hits.
„ „ ..	= „ ..	..	4′ × 6′ strong wind	= 3·9 × 5·9 ..	78 „
„ „ ..	= „ ..	..	„ no wind	= „	90 „
1000 „ ..	= 820 ..	..	10′ × 13′ Swiss, or 9·8 × 12·8 ft.		100 „
„ „ ..	= „ ..	..	8′ Swiss, or 7·9 ft. Eng. square		96 „
„ „ ..	= „ ..	..	4′ × 6′ Sw., or 3·9 by 5·9 ft. E. sq.		66 „

With wind blowing, the number of hits at the last named distances were 92, 86, 58.

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* At the instance of Colonel Wurstemberger, it seems that, quite lately, the patch used with the rifle is to be abandoned for many reasons, a mixture of grease and wax is to replace it. Simultaneously with the above, a slight alteration of the front part of the rifle bullet has been proposed. After some experiments regarding these alterations, it appeared that, at a temperature which frequently rose as high as 30 deg. R.. or 99·5 deg. F., 380 rounds could be fired at various intervals of time within two days from a rifle loaded with the old powder, which was not always of the best, without once wiping or washing out the barrel, and that the loading of the last round was as easy as the first.

The rest of the rifles used in these experiments, fired with the new pointed bullets, approached more or less nearly to the above results; the practice of the rifles, with very light bullets, however, was not so good; in general, it here again appeared in practice, that the heavy bullet with like calibre and charge, acquitted itself better than the light one.

Still more remarkable is the difference between the cylindro-conical and the spherical bullets. For example, the "ordnance rifle," from Berne, experimented on in 1847, with its ball of 21 grammes (324 grains Eng.), made the following percentage of hits:—

200	paces Swiss	= 164 yds.	in a target of 8′ Swiss square	= 7·9 ft. Eng.	100 hits.
”	” ..	= ”	4′ ..	= 3·9 ..	100 ”
”	” ..	= ”	2′ ..	= 1·9 ..	85 ”
400	” ..	= 328	8′ ..	= 7·9 ..	87 ”
”	” ..	= ”	4′ ..	= 3·9 ..	60 ”
”	” ..	= ”	2′ ..	= 1·9 ..	20 ”
600	” ..	= 492	8′ ..	= 7·9 ..	40 ”
”	” ..	= ”	4′ × 6′ ..	= 3·9×5·9	30 ”

At greater distances the probability of hits was absolutely *nil*, while the same rifle, when loaded with cylindro-conical bullets at 600 paces or 492 yards, gave from 83 to 100 per cent. of hits.

If these data be compared, we perceive that the superiority of the pointed bullets over the spherical exceeds in the duplicate ratio; this superiority is still more evident with a strong wind blowing.

The Commission in its report says as to range:—"The effective range of the spherical bullet does not exceed 600 Swiss paces, or 492 yards, while the limit for the pointed bullet extends up to a distance at which the eye of the marksman can no longer perceive the object, and at which, consequently, every reasonable use of a portable fire-arm must cease."

The above-mentioned weighty observation as to the flatness of the trajectory curve of the pointed bullet, again made itself apparent with this model of rifle, when compared with that of the spherical bullet. The greatest height of the trajectory curve of this new model, at 600 Swiss paces or 492 yards, amounted to 8·5′ Swiss, or 8·4 ft. English, while that of the spherical bullet at the same distance was 18′—19′ Swiss, or 17·7—18·7 ft. English; the height of the trajectory curve of the pointed bullet is consequently not half so great as that of the spherical; whence, too, follows this advantage, that if the marksman turn aside the weapon in aiming, the deviations to one side cannot be so considerable.

Further, it appeared with equal clearness in these experiments, that when the bullet having no patch has to be driven into the grooves by means of the rammer, as in the Austrian chambered and Sardinian rifles, a diminution in uniformity of effect and probability of a hit took place.

The elevations necessary for the rifle at the various distances were: for 400 Swiss paces, or 328 yards, 35′; 600 Swiss paces, or 492 yards, 1° 3′; 800 Swiss paces, or 656 yards, 1° 38′; 1000 Swiss paces, or 820 yards, 2° 9′;.

The percussive force of this arm may be seen by the following data:—The bullet of this model at 800 Swiss paces, or 656 yards, traversed five one-inch=1·182 inch. Eng. deal boards; at 1000 Swiss paces, or 820 yards, three similar boards, and stuck in the fourth; while, on the other hand, the American rifle at 500 Swiss paces, or 410 yards, only pierced three, and Wild's rifle only one.

The French pillar-breech rifle of 1846, according to the data of the school of musketry of St Omer, at 800 Swiss paces, or 656 yards, pierced five poplar planks, of which each was 7 lines 3 points Swiss, or 0·86 inch Eng., in thickness; the total thickness of the boards thus amounting to 3″ 6 lines Swiss, or 4.26 English inches. We have seen above that the Federal rifle of the model of 1850, at the same distance and almost equal charges (that of the French pillar-breeched rifle being 4·5 grammes, or 2·56 drams, while that of the Federal rifle is only 4 grammes, or 2·27 drams), pierced through 5″ Swiss, or 5·9 inches English.

Certainly poplar wood is more spongy than that of the fir tree, but the greater number of boards traversed fully outweighs this impediment.* If now the weight of the French bullet be compared with that of the Swiss rifle, the former (47·5 grammes, or 733 grains,) being nearly three times as heavy as the latter (16·6 grammes, or 256 grains), the greater power of bitting will evidently lie on the side of the latter.

According to the received opinion, circumstantiated repeatedly by experiments in Denmark aad Prussia, that a bullet, which perforates a one-inch soft board, would likewise put a man *hors de combat*, and that to pass through him it ought to pierce four similar boards, we may justly assume the percussive force of this new model rifle to be perfectly adequate to the purpose for the distances above mentioned.

In the experiments 120 rounds were fired one after the other, without rendering the act of loading more difficult from the residuum of the powder, which circumstance must be ascribed to the use of the patch and the shallow rounded grooves.

The lock of the new rifle has only one bent, as a half-bent appears to be unnecessary, according to its original intention, with the introduction of the percussion system; because the cock when lowered always covers the nipple, and consequently its vent; but in the flint lock this is not the case, as the steel is thrown back by the fall of the cock, thus leaving the pan uncovered.

THE SWISS SYSTEM.

Almost simultaneously with the appearance of the Minié rifle, the new American system was deliberated upon in Switzerland, and after a series of very extensive experiments as to the power to be ascribed to various weapons, in the year 1850 a modification of the American system was adopted for riflemen. The arm thus introduced bears the name of "the new Federal rifle."

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* Sic in orig.

In this system a very small calibre is adopted ; the grooves of the rifle are semicircular, and make nearly a complete revolution in the length of the barrel. It is fitted with a chambered breech. The bullet is not in contact with the charge, nor does it touch the breech ; it is put in with a patch.

The piece is of the following dimensions:—The length of the bore is 2′ 7″ 1‴ Swiss, or 32·04 Eng. inches. The normal calibre is 0″·35 Swiss, or 41·38 Eng. inches. The semicircular grooves are equal in width to the lands, and are 1·5‴ (points) Swiss, or 0·018 Eng. inch deep. Their twist is equal to 33⅓ of the whole circle per foot length, consequently 0·9033 in the whole length of the bore, giving an inclination of 88° 56′ 54″. The chamber of the patent breech is 0″·85 Swiss, or 1·004 Eng. inches deep, and is bored to a depth of 0″·35 Swiss, or 0.414 Eng. inch.

The sight, attached at 4″·4 Swiss, or 5·91 Eng. inches, from the end of the barrel, consists of two circular cheeks having a sight piece playing between them on a hinge ; the latter can be fastened at any given elevation by means of a thumb-screw, passing through the right cheek, and a spring ; on the outside of the opposite cheek is the graduation from 200 up to 1000 paces Swiss, or 155·124—775·625 yards.

The whole length of the rifle with bayonet is 5′ 8″ 5‴ Swiss, or 69·16 Eng. inches ; its weight is between 9½ and 10 lbs. Swiss, or 10·47—11·02 avdps. English lbs.

The bullet is of the "cylindro-ogivale" form, and has a groove near its base of small depth, and sloping upwards ; to this groove is fastened by a piece of packthread a patch, covering the base and lower rim of the bullet. Its greatest diameter, which is at the ring at the base, is 0″·346 Swiss, or 0·409 Eng. inch; whereas the diameter of the upper part is only 0″·335, or 0·396 Eng. inch. The "ogivale" part, which is 0″.782 Swiss, 0·925 Eng. inch in length at its junction with the ring at the base, is 0″·314 Swiss, or 0·371 Eng. inch in diameter. The whole length of the bullet is 0″·99 Swiss, or 1.169* Eng. inches: its weight should not exceed 1-28th, nor be less than 1-32nd, of a Swiss pound, or 275·5—239·6 Eng. grains. (Figs. 2 and 3.)

Fig: 2.

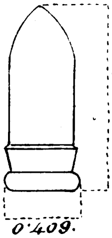
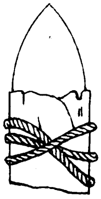


Fig: 3.



The charge should not exceed $\frac{1}{120}$, nor be less than $\frac{1}{130}$ of a Swiss pound, or 2·35—2·17 drams avdps. English. The cartridge is made of well-sized paper. The bullet, surrounded by its patch, is carried separate from the cartridge in a sportsman's pouch, in which, besides the 60 cartridges and 80 caps, is a corresponding weight of lead (2 Swiss lbs., or 2·2 Eng. avdps. lbs.), and 60 patches, with an adequate quantity of packthread: this forms the pouch equipment.

The patch is made of white cotton cloth soaked in grease.

In loading, the packthread, which as above-mentioned fastens the patch to the bullet, should be stripped off before the latter is introduced into the piece; for this purpose it should be moderately thick. On the steel ramrod is rivetted a shoulder, which only admits of the bullet being set home so far as to leave an empty space of 1·5 to 2 lines Swiss, or 0·177—0·237 English inch between it and the charge.

In addition to the ramrod, a brass starter for entering the bullet is used.

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* The dimensions as given in the figure are 0″·935 English inch.

Towards the end of 1853, after a series of highly successful experiments, a new weapon was adopted for the Jägers, under the name of the "Jäger rifle". It admits of an equally small charge; it is 1 lb. Swiss, or 1·1 lb. avdps. English, lighter, and has much less recoil than the Minié rifle, and far surpasses that weapon for accurate shooting. At a distance of 2,500 Swiss feet, or 820 yards, the little bullet of the Jäger rifle pierces through three one-inch (Swiss, or 1·18 inch English) planks. In the Swiss "Militär-Zeitschrift," 19th annual series, 4th number of 1853, it is stated: "The weapon is simple, easy to load, and shoots at considerable distances with an accuracy which is only to be equalled by the percussive force of the bullet, and fulfils, consequently, all the conditions generally required of such a weapon in war."

This Jäger rifle is almost of the same nature as the Federal rifle.

The barrel, precisely similar, without the breech, is 2′ 7″ 1‴ Swiss, or 32·04 Eng. inches; its calibre is 3 lines 5 points, or 0·4138 Eng. inch, it has 8 rounded grooves, whose twist would make a complete revolution in 3 Swiss feet, or 35·47 Eng. inches, or $\frac{9033}{10000}$ parts of a complete revolution in the length of the barrel, giving an inclination of groove of 88° 56′ 54″; a maximum of 1·0423, and a minimum of 0·8468, is allowed. The depth of the grooves ought to be between 0·012″—0·015″ Swiss, or 0·014—0·018 Eng. inch, and the lands equal to the grooves. The chamber has the same bore as the calibre of the piece, and is 0·85″ Swiss, or 1·004 Eng. inch deep.

The sight carrying its moveable plate is the same as in the Federal rifle: it is attached to the barrel, at 4·4″ Swiss, or 5·249 Eng. inches distance from the end of the barrel, reckoning from the axis of the sight, and is furnished with the proper graduation for 200, 400, 600, and 800 paces.

The height of the sight above the axis of the piece for

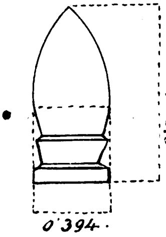
200	Swiss paces	=164	yards, is	6	lines	3	points Swiss,	=0·745	inch.
400	„	=328	„	7	„	6	„	=0·898	„
600	„	=492	„	9	„	4	„	=1·087	„
800	„	=656	„	11	„	4	„	=1·348	„
1000	„	=820	„	13	„	9	„	=1·644	„

The height of the muzzle sight is 5 lines 4 points, or 0.638 inch above the axis of the bore. It is not fixed immediately on the barrel, but on the upper band.

The length of the Jäger rifle without bayonet is 4′ 1″ 3‴ Swiss, or 48·828 English inches, with bayonet it is 5′ 8″ 3‴ Swiss, or 68·926 English inches, and its weight, including bayonet, is 9·9 lbs. avdps.

The bullet, like that for the "Federal rifle" has a "cylindro-ogivale" form; its greatest diameter is 0·335″ Swiss, or ·394 Eng. inch: this diameter is measured at the junction of the cylindrical with the oval part. The cylindrical part is 0·326″ Swiss, or 0·390 Eng. inch, and carries two grooves: it slightly diminishes in diameter from the junction above alluded to towards the base, the diameter at the base being 0·321″ Swiss, or 0·380 Eng. inch. The whole length of the bullet is 0·79″ Swiss, or 0·941 Eng. inch: its weight varies between 1-28th and 1-32d of a Swiss lb., or 275·6—241·2 English grains. (Fig. 4).

Fig. 4.



The cartridge consists of a tightly-rolled case of writing paper, the edges being unpasted; it contains a charge of 4 grammes, or 2·26 drams avdps., of musketry powder, and a bullet placed point uppermost: the latter is separated from the powder by a paper wadding. The lower end of the cartridge is turned over the base of the bullet, and is endued with a mixture of 4 parts of tallow and 1 part of yellow wax, as high as between 2—3 lines Swiss, or 0·24—0·36 Eng. inch, from the bottom; the upper end is turned neatly over the top of the powder and bent downwards. Every rifleman carries an ammunition equipment on active service, 6 packets of 10 cartridges each: the caps, 78 in number, are carried in a separate piece of paper, each cartridge packet containing an adequate number of caps, viz., 13.

The method of loading is the same as with "the Federal rifle," but without the patch, as in this instance the greased cartridge-paper covering the lower end of the bullet, which is put down with the bullet, performs the office of a patch. Further, the ball is not put down home on the powder, but a definite empty space intervenes.

In addition to the steel ramrod, a brass starter, 18 Swiss inches long (21·281 Eng. inches), is used to enter the bullet into the piece.

The following are the results of experiments made with the Jäger rifle. With reference to the probability of a hit: 95 per cent of hits at 400 Swiss paces, or 328 yards, in a target 8′ Swiss square, or 7·9 feet English; 63 per cent of hits in a strong wind at 600 Swiss paces, or 492 yards, in a target 12′ Swiss long by 9′ Swiss high, or 11·8 by 8·9 Eng. feet; in still weather at the same target, at a distance of 656 yards, the percentage of hits varied between 80 and 87.

The angles of elevation of the Jäger, the Federal, and the Minié-rifles for the undermentioned distances are as follows:—

	Jager-rifle.			Federal-rifle.			Minie-rifle.		
	°	′	″	°		″	°	′	″
400 Swiss paces=328 yards.........	0	25	30	0	35	10	1	21	0
600 .. .. =492	0	54	20	1	3	20	1	51	0
800 .. .. =656	1	21	40	1	38	50	2	43	0
1000 .. .. =820	1	52	40	2	9	0	3	34	0

From the above it is evident that the Jäger requires much less elevation than does the Federal rifle—a circumstance which is to be ascribed to the smaller amount of friction of the bullet in the bore of the former in comparison with that in the latter. The elevation necessary to the Minié-rifle, on the other hand, is double, and it must consequently usefully command a far less amount of ground.

Equally favourable results have been attained with this rifle in reference to percussive force, since its bullet at 800 Swiss paces, or 656 yards, pierces five one-inch deal boards, while at 1000 Swiss paces, or 820 yards, it perforates four similar boards; in contrast with this, according to the experiments in France with the Minié rifle, at the former distance only three or four one inch planks were penetrated; and finally, the bullet of the French wall-piece at 800 Swiss paces, or 656 yards, traverses but one board of 7·5 Swiss lines, or ·88 inch English.

Very interesting experiments* with reference to the percussive force of the Federal and Jäger rifles were carried on at Thun in Switzerland on the 16th of January, 1855, under the direction of Colonel Wurstemberger and Lieut. Colonel Wehrli. The charge and bullet for both pieces were alike, and in all other circumstances absolue uniformity was maintained. The object fired at was a horse killed just before the experiments. Such an experiment upon the dead body of an animal which continued warm during the whole of the time occupied, is the more interesting, as under such circumstances the percussive force of a war weapon could be far better appreciated than by firing at wooden targets.

For this purpose the dead body was placed astraddle on a scaffold, while the head and neck were supported as nearly as possible in their natural position by means of two pieces of timber forming sheers.

The results at 100 Swiss paces, or 82 yards, on the fore part of the body were as follows:—one bullet made a round hole in the middle of the forehead, without splintering the bone, perforated the brain and nape bone, and, splitting the skin at the head of the windpipe, passed out: a second bullet pierced the bone of the nose without splintering it, and, passing through the palate and hollow of the mouth, made its exit at the glands about the head of the windpipe: a third traversed the breastbone, and wounded several important parts, such as the arm and the elbow-joint, near which it passed out. Similar results were obtained at the same distance on the hind quarters of the body, one shot having perforated the upper portion of the greater thighbone, passing out at the stifle-joint.

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* Extracted from "Uebersicht des Ergebenises des zu Thun an 16 Jannar, 1855, auf Anordnung der Verwaltung des eidgenossichen Kriegsmaterials, &c." entnommen.

At 300 and 400 paces, or 246 and 328 yards, firing at the right side of the body, the bullets shattered the ribs, and either passed through the body or stuck in the opposite ribs or in the cellular tissue of the skin. The results of these shots attest that at 100 paces, or 82 yards, the greater part of the hits would have occasioned instantaneous death, while the remainder would have been attended with speedy death, or would have put the animal *hors de combat*. Two shots with the muzzle of the pieces close to the object, and fired in a kneeling position, would have likewise caused instantaneous death.

At 200 paces or 164 yards, the hits could not be accurately recognized in consequence of a violent snow storm, but at 300 paces, or 246 yards, the whole of the hits would have occasioned death. A similar result was attained, with the exception of a few shots, at 400 paces, or 328 yards, most of the bullets shattering the ribs, and then passing on stuck in the opposite ribs.

These extremely interesting experiments prove in the most striking manner the very great percussive force of a bullet fired at a small elevation—for it appears that a bullet fired under those circumstances, like that of the Swiss rifle, which, as we have seen, is remarkable for the little elevation it requires, pierces and shatters large bones, such as the breastbone, skull, and ribs, and that continuing its path it tears the intestines, which are of an elastic and spongy nature, and still possesses sufficient momentum to proceed on its course through the skin or to enter to a considerable depth into the ribs on the opposite flank.*

M. L.

Remarks on the Formation of " Fours", and the " Locking Up" of the rear Rank as it bears on that Formation.

Having completed the command, " Fours deep," the left file of the rear rank will stand just sixty inches, or two clear paces, from the right files of the Front rank. On the move to a flank the men naturally ease their files when the distance will be something more.

When " advancing" the rear rank " locks up" to within twenty inches of the front rank, so that on the word, " Fours right," the same left files, after turning, have to take two side steps with their own right files, one more to clear them, and one forward to get abreast of them. Thus it is necessary for the right files of the front rank to " mark time," four paces, to admit of all this to be done, if done with exactness.

Whatever the instructions may be for " Fours left," it will be found in practice, *on the move,* that the left files are always inclined to *wheel* on their right files, and when formerly Adjutant of the Royal Dragoons I instructed the men to do so. As this is the easiest and most simple way for men to move I would suggest that " Fours right," and " Fours left," be always formed by the right and left file of each rank *wheeling,* the right file wheeling *up,* and the left file *back* in " fours left", and the left file wheeling *up* and right *back* in " Fours right," then, by keeping the rear rank at its proper distance, thirty inches, there would be no necessity for its stepping back at the word " Fours," or of closing up at the word " Front."

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* Colburn's United Service Magazine, October 1856.

As "Fours deep" and "Fours about" can, I believe, be only necessary in the "passage of lines," they need not interfere with "Fours right" or "left."

However the formation is made the men ought never to move until the last sound of the word of command. The rear rank of a squad, or company, may move at the word "Fours," but let any one watch a regiment in line, or a column, if in Brigade, and see the straggling unsoldierlike way in which the men step back; nor can it be otherwise, as it would be impossible to find in our language a more indistinct word for an executive command than "Fours."

Whatever the advantages may be (and I know of none except when firing or in square), in having the rear rank "locked up", now that "Threes" are abolished, they would be more than counter balanced by keeping the rear rank always at *thirty inches*, and by *wheeling* the Fours, for the following reasons:—

1st.—Hundreds of good men, annually, would be spared extra drill for not "locking up," as nothing will induce men to march in that constrained position but constant threatenings and punishment.

2nd.—There would be no necessity for the men of the rear rank to step back at the word "Fours," nor would they be obliged to break one of the fundamental rules in marching by taking a short step at the word "halt." Even with a single division it requires an experienced drill so to time his word of command that the men shall all halt together. But in battalion drill or in brigade the word is given without attention to this, so that the rear rank cannot possibly take a short step; it is, in consequence, too close. For this the men get bullied and irritated, and the luckless wight who endeavours to correct his distance is marked for drill for being unsteady in the ranks. Instead of hundreds there are thousands annually marked for drill, not for any fault of their own, but for endeavouring to correct the fault of the system.

3rd.—It would convert two short, indistinct, *executive* commands into one *preparatory* command, and

4th.—Would obviate two preparatory movements before the troops were in motion to a flank. And nothing looks more beautiful to the soldier, or so magic-like to the civilian as a large body of men moving off to a flank without any preparatory formation. The preparatory command being "Fours right." the executive, "Quick march," when the men would *wheel* and move off, without even the word "forward."

5th.—It would obviate the delay in "Front turn," from "Fours" occasioned by the right files of the front rank having to mark time, four paces, if *done according to instructions,* two for the left files to get up, and two for the rear rank to close, it being forty inches from its locking-up distance. This in practice is seldom done, the men jostle into their places, the right files advance too soon, and the rear rank men have to scramble on until they get to their locking-up distance.

6th.—The right and left files would never loose the *touch,* and the rear rank would be always dressed, which is seldom the case at present.

The regiment having "passed by Fours, from the right of divisions to the front," gets the command "form line."

7th.—The leading files, if desired, could either continue the advance, the others doubling up, *in succession,* or the leading files could halt, and at once open fire, neither of which could be done from the present formation of "Fours," if they were to act agreeably to instructions, viz:—to form two deep, and bring the shoulders forward as in "front form company" from files.

There are many occasions where an alteration in the present method of forming "Fours" may be of vital importance, such as the proximity of the enemy; forming line on broken ground; skirmishing supports forming to the front, or right, or left, to gain cover, &c.

In all these formations the rear rank men must "mark time" until they are in line with the front rank men, immediately in rear of them; these four men will arrive on the line of the rear rank together, the rear rank men halting in their places, the front rank men taking theirs at the next place. And this is the only way in which the formation *from files*, to the right or left can be done correctly. The instructions in the Infantry Manual, page 79, are so inconsistent, that to carry them out is purely impossible, as are also those at page 53, "Prepare to resist cavalry." How is it possible for a man, standing in the centre of *twenty-one* inches, to take a pace of *nine* inches to his front?

8th.—But the great and primary advantage is the free and unconstrained march of the soldier. At present the fatigue of the men of the rear rank, in comparison to that of the front, is as *five* to *four*, and their chances of being marked for drill, is as *five* to *one*.*

(Signed) R. C. Noake,
Captain and Adjutant, Dumfries Militia.

Extracts from "Principles of the Minor operations of War." translated from the French of Lallemand, by St. Vincent Troubridge, Major 7th Royal Fuziliers.

1. *On Out-posts.*

Out-posts have a double object,—the safety of the corps which establishes them, and the observation of the enemy's troops. They should consequently be so posted that they may not only perceive the movements and approach of the ememy, but may, moreover, in case of attack, be enabled to arrest his progress, and give the troops which they cover, time to get under arms and make their dispositions for defence.

When the army is covered by its advanced guard, the out-posts form an external chain to cover the latter; and when the advanced guard is encamped with the army, as sometimes occurs, the chain of out-posts should be immediately beyond the camp : in either case the mode of posting them is always the same.

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* Colburn's United Service Magazine, September 1858.

The nature of the ground decides the class of Troops of which the out-posts should be composed.

In an open country, they should be composed of cavalry ; in a broken country, of infantry and cavalry ; and in a very rugged country, of infantry alone ; except in cases where a few mounted men should be given as orderlies. The nature of the ground also decides the distance to be left between the line of the out-posts, and that of the main body. Were this distance too great, the out-posts might be carried off before relief could reach them : were it too small, the principal object, namely, the safety of the army, would not be obtained.

On these considerations, we may fix on three-quarters of a league (about two miles) as an average distance to be kept between the line of the most advanced posts and the main body ; bearing in mind that this distance should be increased the night after an action ; and also whenever it may be requisite to hold a post for a considerable period, in order to avoid harassing the troops by keeping them constantly under arms.

The extremities of the line of out-posts should find points of " appui" in the nature of the ground, and should overlap both flanks of the position of the army, so as to occupy and observe all the avenues by which the enemy might advance. In default of points of " appui" the extremities of the line of out-posts should be thrown back towards the army ; and in this case, for greater safety, picquets of cavalry or infantry, according to the nature of the country, should be thrown out to their front and flanks, in order to observe and reconnoitre by means of frequent patrols, all the ground under their surveillance, The line of out-posts should have some natural obstacles in its front; and to these, and the difficulties of the ground, should be added the resources presented by field fortification.

When the line of out-posts is not covered by any natural obstacles, the vigilance of the posts and the activity of the patrols must supply that safety which is denied by local resources.

If the out-posts have a double object, the troops of which they are composed have also a double vocation, namely, to observe the enemy, and to obstruct his progress.

As soon as the line of the out-posts has been determined, the troops of observation are established there. These troops should be distributed on the most important points of the line, and particularly on those from which the out-posts may be best able to command a view of the country, as well as of the approaches open to the enemy's army, assigning to each arm, the ground most suited to the nature of its service..

Troops of observation are divided into grand-guards or rallying posts, and advanced posts.

The grand-guards are established under cover, so far as the ground will allow, in hollows, behind heights, embankments, brushwood, dykes, streams, and, more particularly, on each of the directions leading towards the enemy.

They should detach to their front and flanks, at a distance of about 200 paces, advanced posts, the strength of which should not be more than one-third of their own. These posts are to furnish the videttes, or sentries, who form the outer chain; and their strength should be calculated in the proportion of four men for each vidette or sentry.

This chain should embrace a larger extent of ground than the line occupied by the advanced posts; and should be from two to three hundred paces in front of the latter.

The videttes, or sentries, forming the outer line, should be so posted as to be able to see each other, in order that the enemy may be prevented from slipping between them and the advanced posts, thus breaking the chain which would soon be destroyed if taken in flank.

The communication between the outer chains and the posts should be kept up by frequent patrols, more particularly during the night and at day-break. These patrols should be so vigilant as to prevent anything from passing the posts without being discovered.

The grand-guards should never be separated from the advanced posts by obstacles, such as streams, marshes, steep ravines, or defiles. They should both be posted on one side or the other of such obstacles; but it is advisable to have them in their front when this can be done without breaking the connection of the different parts of the line.

The second object of out-posts is to gain time. It is on this account that they should consist of detachments sufficiently strong to resist the first attack of the enemy, and sustain a combat. These detachments which are called posts of "appui," should be composed of infantry, cavalry, and artillery; distributed with regard to the nature of the ground and the strength of the main body.

The posts of "appui" should occupy those passes by which the enemy might advance with facility; and particularly those where the ground would permit of a certain amount of resistance, such as defiles, villages, or points where several roads cross.

A strong detachment should be stationed at any weak point between the army and the posts of "appui," as much to cover their retreat as to prevent the enemy from seizing the point by a flank march. Should the line of the posts of "appui" be too extended, it would be advisable to establish intermediate posts to connect them, and also to facilitate the transmission of orders and reports.

In order to enable the posts of "appui" to resist the enemy as long as possible, the openings towards his posititon should be narrowed, his points of attack should be circumscribed, and those only left open where the difficulties of the ground are most formidable.

The posts of "appui" should not be too far in rear of the grand-guards, because they are intended to rally them, and cover their retreat; neither should the main body be too far from the posts of "appui," lest they should not be able to fall back without compromising their safety.

Supposing the greatest distance between the main body and the line of advanced posts to be about three miles, that between the posts of "appui" and the main body should be about a mile and a half.

The posts of "appui" should be established on a line corresponding to the general direction of that occupied by the grand-guards.

Although the posts of "appui" are covered by the grand-guards, it is not the less necessary for them to throw out on the flanks of these guards smaller posts, as much for their own safety, as to cover the retreat of the posts established in the first line.

The commander of the advanced corps, should take post with his artillery and the main body of his force, on the central point of the line of posts of "appui;" the safety of the out-posts and even of the advanced corps often depends on the selection of this position.

As soon as the advanced posts, the grand-guards, and the posts of "appui" are in position, they should be made acquainted with the place of rendezvous, the routes they must follow to reach it, and the ground they should occupy.

The exterior chain of sentries and videttes should occupy, as has been already said, a line much more extensive than that of the advanced posts; the advanced posts a line more extended than that on which the grand-guards are established; and the latter one more extended than that occupied by the posts of " appui". These last being intended to support the advanced posts, and to guard the principal approaches leading to the position of the army, should be more concentrated, by which means they will be enabled more easily to afford each other mutual support, and to resist with success the efforts of the enemy.

The amount of resistance to be made by any post, should always be determined with regard to the object in view; and should be proportioned to the importance attached to the occupation of the post.

As soon as the videttes or sentries have made known by signals the approach of the enemy, and they perceive that he continues to advance, they should fall back on the advanced posts; and as soon as these have called in all their videttes or sentries, they retire on the grand-guards, which, in their turn, after having rallied all their detached posts, and ascertained that a considerable body is advancing, and not merely a patrol of the enemy, retire on the posts of " appui," skirmishing, and retarding as much as possible the advance of the assailants, without however compromising their own safety.

The posts of " appui," which have got under arms on the first alarm, do not retire until they have recalled and assembled all the detachments on their front and flank. These posts should offer a vigorous resistance, not only to oblige the enemy to show his strength and real intentions, but also to enable the advanced corps and the army itself to get under arms, and to make such dispositions as are in their power, and the circumstances of the case may demand.

The Officer Commanding the whole force should alone decide if it is necessary for the out-posts to make an obstinate resistance, although the numerical strength of the enemy may be superior to his own. In an infinity of cases this becomes necessary; for instance, the commander may desire to gain time for the purpose of effecting some offensive movement without the knowledge of the enemy; or again, deeming it indispensable to retire, he may wish to mask his retreat, and to keep the enemy's forces at a sufficient distance to prevent them from harassing him, &c., &c.

It is for this reason, that in either case, the out-posts should be sufficiently strong to be able to resist the enemy, and keep him in check without running too great a risk.

Such are the general rules and details which should be observed in the composition and distribution of the out-posts, and in the selection of ground with reference to the position of their lines.

2. *On Patrols.*

Patrols are of two sorts,—offensive and defensive.

Defensive patrols, as we have already remarked, are charged with the safety of their posts, and are to assure themselves that nothing can pass between their intervals without being discovered. These patrols need not consist of more than three or four men, as they have only to act a passive part; and should not advance more than very short distances beyond the chain of videttes.

Offensive patrols, on the other hand, should be composed of a larger number of men, and this number should be regulated less with regard to the nature of the ground than to its extent and depth. For example, a patrol whose force amounts to twelve or fifteen men, will suffice to explore a country some leagues in depth. Whereas, were the country the same number of leagues in breadth, forty or fifty men would be necessary.

The object of offensive patrols is to explore the position of the enemy, to watch his movements, to reconnoitre his forces, as well as the nature of the ground, and the distance that must be traversed in order to reach him.

From this summary may be seen what precautions are necessary in order to accomplish these operations. The importance attached to them, the obstacles and difficulties presented by the distance from the enemy, the necessity of relying solely on the capacity and courage of the leader, are so many considerations which should be taken into account in selecting the Officer to command a patrol charged with a reconnoissance of the enemy. This Officer should use every possible means to obtain the required information without being impeded by the enemy.

It is only from the nature of the ground and the object in view, that the description of troops and number of men can be determined, which should compose the patrols. When, for instance, operations are carried on in an open or slightly broken country, and the distance to be traversed before reaching the enemy, or the point to be reconnoitred is great, the patrols should be composed entirely of cavalry; whereas, in mountainous countries, or in short, whenever the communications are few and difficult, and where the patrols have but a small extent of ground to pass before reaching the vicinity of the points proposed to be examined, they should consist of infantry. There are cases where it would be advisable to add a few mounted men; because these can, if necessary, pass rapidly from the head of a patrol to its flank, and may connect more closely several different patrols.

Officers commanding patrols, which are to be pushed to considerable distances, will find many advantages in having a special map of the country to guide them. These officers should take note of the principal points towards which they direct their march; and should observe with the most scrupulous attention the country they traverse; so that in the event of falling in with the enemy in an unfavourable situation, they may (since this description of patrol should endeavour to avoid an engagement) fall back without loss of time on more advantageous ground. They should also take the precaution to procure guides, and make what use they can of the inhabitants of the country; being careful to divert the attention of the latter from the real object in view, by putting questions on entirely different subjects.

Before deciding on the precise order of march of a patrol charged to explore a certain extent of country, we must previously know:—1st. The numbers and composition of the patrol; 2nd. The nature of the ground to be traversed; 3rd. The considerations due to the weather and the season; 4th. The object proposed to be obtained.

This information being acquired, the following is the substance of the principal rules to be attended to:—1st. In every movement, it is necessary to be extremely circumspect; 2nd. The march should be covered and protected without too great a separation of the troops; 3rd. The flanks and rear must be well reconnoitred; 4th. Care must be taken not to allow the patrol to be cut off; 5th. All the defiles to be passed must be carefully reconnoitred by men sent on in front for that purpose; 6th. Every possible use must be made of the information derived from the inhabitants; 7th. Should a forest have to be traversed during the night, certain signals must be agreed on beforehand; Lastly, The greatest attention must be given to every thing that occurs: the barking of dogs, fires lighted or extinguished, any noise or cries on a road, deserve the attention of every leader of a patrol. He should see every thing himself as far as possible; and before trusting to any new intelligence, he should obtain information from different quarters. Should any prisoners be taken, although this is never to be attempted by engaging the enemy, their statements must be compared with those received from other sources. In operations of this description, too much timidity would be as bad as too much audacity.

Attacks and surprises must be avoided by all possible means. Those roads must be preferred by which the movements may be concealed from the enemy, and more particularly those which present at the same time the means of escaping him, and continuing the march in safety.

It is in operations of this description that presence of mind, reflection, cunning, prudence, and audacity must be employed simultaneously or in turn, according to circumstances: for, however detailed may be the instructions given to the officer commanding a patrol charged to explore a country, or to push on to the advanced posts of the enemy, they can never embrace beforehand all the situations in which he may be placed by a thousand unforeseen events.

Such are, in part, the general principles which should guide all officers charged with the management of a patrol intended to beat the country and work up to the line of the enemy's advanced posts.

3. *On Reconnoissances.*

Of the different branches constituting the science of war, that of military reconnoissances is one of the most essential; and officers of all classes, without exception, cannot take too great pains to make themselves skilful in it; not only because the results of reconnoissances enter into the combinations of all military operations, which can not or ought not to be decided on without a previous knowledge of the ground on which it is proposed to act, but also on account of the intimate connection which this branch has with tactics and strategy.

The knowledge of a country must be distinguished from that of ground; the first has for its object, to obtain general information of the nature of the principal local features, such as rivers, marshes, woods, mountains, high roads, and fortresses; and of the resources, such as corn, forage, and cattle, to be found in the country about to be the seat of war, so as to be able to decide what means may best be employed to effect the necessary dispositions for conducting the campaign.

A reconnoissance of ground consists in studying, in the most minute detail, each particular locality, in order to regulate the execution of the minor operations of the war.

Knowledge of a country may be acquired by the study of maps, with the aid of descriptive notes; but ground can only be thoroughly known by being traversed in every direction, without overlooking the smallest details, and considering them always in a military point of view.

A general acquaintance with a country leads to and facilitates a more particular knowledge of the ground.

Before commencing operations, it is indispensable to have certain and extensive information respecting the country which will be the theatre of the war, on which to base the general plan of the war and the campaign.

Good maps are sometimes sufficient to allow of a project being determined on beforehand; but when it is a question of regulating details and particular operations, the ground on which it is proposed to execute them should first be well studied.

One of the principal objects of reconnoissances is to obtain information, from which descriptive and detailed notes may be prepared, and annexed to maps; these notes, explaining all the details of a country, will supply what the drawing or engraving is incapable of showing. From what has been said it may be deduced, that, although a knowledge of that particular part of a country where operations are carried on may be sufficient for the general and for the other officers employed there, yet, in order to decide on the plan of a war, or even of a campaign, and to be able effectually to check the projects of the enemy, not only must the country occupied be known, but that also which it is proposed to penetrate, and those which adjoin it in every direction, so as to allow of considering well beforehand what projects will suit the circumstances, and what may be applicable to all the different possible hypotheses.

In studying a country, or a portion of ground, it must first be considered whether, as a whole, it will answer for the desired object; and, afterwards, all its different parts must be examined in the most minute detail: 1st. As to their individual forms; 2nd. As to the connection existing between them. By these two operations it becomes more easy, from a simple inspection of the ground, to seize quickly and to judge with precision of all its capabilities and local peculiarities, considered in a purely military point of view: thus may be known the advantages and inconveniences of a position—an aptitude for which knowledge is acquired only by practice, and is improved and perfected only by constant exercise, as far at least as relates to judging distances with accuracy, a most important point in war.

It is very desirable to be able to form a correct estimate of distances at a glance; and this becomes easy by constantly comparing known and measured distances with others, and then verifying the judgement formed by an exact measurement; for instance, it is important to be accustomed to judge how many battalions or squadrons in line a portion of ground will contain. For this purpose, the extent of front of a battalion being known, a piece of ground must first be measured, in order to familiarize the eye with the required space, and after having endeavoured to judge the distance on other ground, it will be seen by measurement what error has been made.

Thus may be learned by degrees the art of appreciating distances and local dimensions, with the acccuracy necessary for actual practice; but as a couple of square leagues may present a great variety of positions, both offensive and defensive, it is evident that it requires natural talent to distinguish at once which of these positions will best suit the proposed object, and to be able to embrace at one view the adjacent ground, its details, and the uses that may be made thereof.

However exact may be the reconnoissance or military description of a country, its object is not accomplished unless it points out the advantages and inconveniences of the different localities, as well as the means of turning them to account: one local feature neglected or misunderstood may give rise to serious errors and dangerous consequences.

Bearing in mind these considerations, we will now proceed to explain and detail methodically: 1st.—The different objects to be taken into consideration in reconnoitring a country with a view to war and its operations; 2nd.—The reconnoissance of a country which it is intended to invade; 3rd.—The reconnoissance of positions occupied by the enemy. Detachments sent out with the intention of deceiving the enemy, by making him uneasy about some project not meant to be carried into execution, may also be considered as reconnoitring parties. This species of reconnoissance is connected with the operation called "Demonstration," and will be treated of specially in a separate chapter.

The objects of the reconnoissance of a country, or of a portion of ground with the view of planning military operations, are twofold. The first consists in the examination of the local features, comprehending the general nature of the country, as well as the details to be studied in each separate part of the ground. The second object is the application of the result of the first examination to the general and detailed operations of the war.

Should the war be carried in the same direction as the courses of navigable rivers, great facilities of transport may be derived from them; but should it be necessary to ascend these rivers, they would facilitate the operations of the enemy and impede those of the assailant.

A country may consist of plains, or of mountains, or it may contain both; it may be dry or marshy; abounding in wood, or entirely without trees; open or rugged; intersected by rivers, streams, canals, woods, hedges, ditches, ravines dry or filled with water, and lastly by chains of hills &c.

The different descriptions of country may be classified as follows:—1st. Plains; 2nd. Countries covered with woods and intersected with rivers, streams, or heights; 3rd. Mountainous countries; 4th. Maritime countries.

It is easy to become acquainted with a flat country, or with plains but slightly broken, because they are almost always traversed by rivers or streams, and a knowledge of these, of the situations of the cities, towns, and villages, and of the direction of the roads, leaves but few details to be desired, and those easy to seize and to express.

Flat countries those which are fertile being generally much intersected, present in a military point of view, a thousand facilities for all sorts of stratagems; and on this account, require to be reconnoitred with great care.

Wooded countries are more or less intersected. Two sorts may be distinguished: firstly, those covered with large forests, with respect to which it may be well to observe, that they are not everywhere impenetrable, although easily defended, by abattis, redoubts, or by taking up positions commanding the approaches: and again, those where thinly-planted trees of high growth crown the heights, which may then be easily occupied.

Wooded countries of the second description are those interspersed with woods, and having plantations and fields surrounded with hedges. A good knowledge of their roads should be obtained; and although in such countries the impediments frequently vary, they may be easily surmounted by activity and intelligence. It is above all important to open plenty of communications.

Mixed countries, that is to say, those which are partly wooded and partly intersected, are the most common, and the means to be employed in order to become acquainted with them, partake of those used in examining grounds of their respective characters.

The greatest attention must be given to the details of countries intersected by canals, or navigable streams, particularly when they may favour or impede any design.

Mountainous countries are the most difficult to reconnoitre, (see Chapter VIII., on Mountain Warfare.)

The reconnoissance of maritime countries embraces two points; that of the sea and that of the land; both of which, in planning a design, should be equally studied, and taken into consideration together: although they are here separated to preserve order in the details.

1st. The reconnoissance of the sea consists in that of the bays, creeks, sand-banks, and roadsteads. It must be ascertained whether they are open or sheltered, and from what winds; also, whether the anchorage is good: if they are easily reached, and what is their depth of water: whether there are any currents: what winds serve best in making the roadsteads or ports; and what in quitting them: lastly, the advantages or disadvantages of these ports; the most favorable time and height of tide for approaching them; whether there are any spots along the coast which are dry, or nearly so, at low water, and which may be approached or a landing effected there, particularly in the vicinity of any posts or places that the enemy would wish to gain possession of: Whether the sea is generally speaking smooth or rough; and at what periods it may be more or less dangerous: at what point a disembarkation may be effected; and what are the best means of preventing it.

2nd. The reconnoissance of the land should be conducted on the supposed possibility of a descent on the part of the enemy, which renders necessary a plan in two parts, one of which should be always balanced against the other: viz.—1st. The facilities or difficulties the enemy will meet with in attempting to land; 2nd. The means of defence afforded by the country. The first thing to be examined is the nature of the coasts; Are they bold, open, and suitable for descents? It is important to form a correct opinion of all the details which characterize the accessible points, the dangers to which they expose the defenders, and the means of obviating them.

Coasts are bordered by sandy flats, or by low rocks, which render the approach to them more or less dangerous; or else they are protected by cliffs, which if they do not absolutely interdict all access, render it very difficult.

Headlands and capes are suitable for the establishment of forts and batteries intended to defend accessible points; and adjacent islands may serve as advanced works, which, when proper measures are taken beforehand, always impede the attempts of the enemy. The following positions should be reconnoitred—1st. Those most suited for batteries commanding the anchorages, passages, &c; for which purpose plateaux are selected overlooking the coast; the difficulties of a disembarkation are thereby increased; 2nd. Those fit for entrenchments or epaulments opposite the points where a descent may be attempted; 3rd. Those of camps and posts to protect the interior of the country, or at least, its principal places: these should be entrenched and maintained, by force, if necessary; Lastly, all the resources should be taken into calculation which may render more advantageous the positions to be occupied, and may add to the different means of defence. This renders necessary a knowledge of the state of the posts, guard-houses, and batteries, as well as of the total number of artillery protecting the coast, or that may be required for that purpose.

After having examined the coast line in the manner indicated, the nature of the ground in its rear must be considered; it must be ascertained whether the country is open or intersected, traversed by rivers, or dotted with woods, or marshy spots: whether the fields are separated by ditches: whether the roads are hollow and inconvenient: what heights there may be, and if their gorges are spacious, or narrow and cramped, parallel to or at right angles with the coast. With regard to the rivers, which should be ascended for some leagues, their depth and the height of their banks should be examined, as well as the length of their courses, and the number and description of boats that ply on them. It should be known what countries these rivers traverse before reaching the sea: what are their products; and what use may be made of them with reference to the subsistence of the troops already on their banks, or about to be established there. It should here be stated, that as the tides cause variations in the time and mode of passing rivers which have their embouchures in the sea, it is indispensable to ascertain their influence in those under examination.

With respect to the communications necessary to enable troops to be transported rapidly from one point to another, by crossing rivers or streams, it must be considered, whether there is any danger of the enemy's succeeding in breaking down or burning the bridges, as this would render the communications difficult, causing much delay, and impeding the movements of those defending the coast. In this case, such expedients must be resorted to as are best calculated to prevent or remedy such accidents; and should that not be possible, it must be ascertained how far it would be necessary to ascend the rivers or streams, before finding other bridges.

It must be known whether a sufficient number of troops can be placed in the forts, towns, and villages along the coast, to defend them until reinforcements can be sent from elsewhere: also whether magazines can be established, and the means of effectually protecting them: and lastly, what facilities there may be for their transport.

The population of the country must be ascertained, as well as the disposition of the inhabitants; and whether they could be armed in case of necessity. It is also desirable to know whether men employed in the coast guard, custom-house, or other departments, may be counted on: and whether they could, when reinforced by the inhabitants, offer sufficient resistance in case of surprise, whilst the troops were marching from other stations on the points attacked or menaced.

The distances of the different parts of the coast to be defended from the probable starting point of the attacking army should be taken into consideration, as well as the time necessary to traverse them.

Should an invasion by sea of the enemy's country be projected, all the information above indicatad becomes indispensable with reference to the arrangement of the necessary plans. In all cases, it is well to examine the systems of defence adopted on previous occasions; and to correct and improve them, if possible; but if not, new systems must be established.

Lastly, in reconnoitring the country adjoining the coast line, the local peculiarities (which have been already alluded to as existing in all countries) must be taken into consideration.

Whatever may be the nature of the country to be studied, the following information should be procured:—It should be ascertained whether the country is cultivated or uncultivated; fertile or barren: what constitute generally speaking its resources, its commerce, productions, manufactures, and their quantity and quality: what are the seasons of the different harvests; whether they are abundant; whether of corn, wines, or forage: whether the country produces horses and cattle, and of what description.

These details on the fertility of a country and the nature and quantity of its production are very essential; because a general almost always directs his operations and movements according to the resources he can find in grain, forage, &c. It is necessary in an enemy's country, which is generally less known than one's own, to procure correct information on the subject of its capabilities in every particular, in order to know beforehand what may be drawn therefrom for the support of the war, that is to say, for the subsistence and use of the army during a given time; and in order to avoid any miscalculation on this head, the revenues and manufactures of the country should be known with accuracy.

As the enumeration of all these necessary details would require considerable space, and their number might cause some to be forgotten, a table (like that annexed) may be prepared with advantage. The different heads, having each a separate column, are shown at a glance, and a tabular summary of the resources of a country may thus be obtained.

When contributions are to be levied in money or in kind, and the country is likely to be occupied for some time, the demands made should be based on an accurate knowledge of the existing amount of grain, forage, &c.; and should be such as to leave the inhabitants what is necessary for their own subsistence, for that of their cattle, and for seed, so as not to ruin the country, but to render its resources available for future years.

Let us continue the enumeration of the points to be taken into consideration in making a reconnoissance. Is the country healthy or otherwise? Cold or hot? what physical causes affect the health of the inhabitants and of strangers? Are there periodical epidemics? What produces them, and in what seasons do they prevail? How long do they last, and what is the best mode of avoiding them? What are the customs of the country in this respect?

Is the population large or small? Are the inhabitants favourable or the reverse? Are they courageous or timid? Are they capable of rising and retiring to their strongholds, and defending them?

By what routes may the enemy reach your frontiers and penetrate into your country; and what are the approaches to his?

All this information is necessary in order to regulate beforehand the movements of an army and of its different columns, when they are about to be thrown rapidly on the points it is most important to occupy, either with the view of counteracting the designs of the enemy, or of carrying out one's own.

An accurate knowledge of a country is indispensable when movements are to be concealed, or when a retreat is to be effected.

TABULAR SUMMARY OF THE RESOURCES OF A COUNTRY.

Country.	Names of places.				Number of Houses.*	Mills.†		Number of Inhabitants.‡				Carriages.		Horses and Cattle.						Character of the Land, its extent and produce.																																			Description of commerce.	Peculiar Productions				Observations.
														Horses.			Horned Cattle and Sheep.			Cultivated Ground.																		Meadows.					Vineyards.					Timber and Copse Wood.				Untilled and Fallow Lands.								
																						Crops.				Produce.				Consumption and amount required for seed.				Surplus.																										
	Cities.	Towns.	Villages.	Hamlets.		Water Mills.	Wind Mills.	Men.	Women.	Children.	Old and Infirm of both sexes.	Waggons.	Carts.	Draught Horses.	Saddle Horses.	Young Horses.	Oxen.	Cows.	Sheep.	Number of Acres.	Quality.	Wheat.	Rye.	Barley.	Oats.	Wheat.	Rye.	Barley.	Oats.	Wheat.	Rye.	Barley.	Oats.	Wheat.	Rye.	Barley.	Oats.	No. of Acres.	Quality.	Produce in For'e.	Consumption.	Surplus.	No. of Acres.	Quality.	Produce.	Consumption.	Surplus.	No. of Acres.	Produce.	Consumption.	Surplus.	No. of Acres.	Capable of Cul.	Incap. of Cul.		Description.	Quantity.	Quality.	Uses.	

* This column should be divided into five, the four first shewing the number of houses in the cities, towns, villages, and hamlets; the fifth containing the chateaux, detached houses, &c. † It should be mentioned whether they are of wood or stone.

‡ The men and women may be divided into different classes, or they may be entered according to age. The Children may also be entered in separate columns for boys and girls, and may be classed according to age.

Where may magazines and depôts be established? Must the convoys be conducted by land or water? Will it be possible hereafter to transport these magazines by means of waggons or boats, and to re-establish them with safety in case of any change in the circumstances of the campaign, that is, should it become offensive, instead of defensive, or *vice versa*?

What are the principal camps and posts to be occupied with infantry or cavalry, or with corps composed of both arms, in order to be absolute masters of the country, to keep it in check, and to protect the magazines? Which are the shortest and safest routes leading to these points, and by which an easy and free communication may be ensured between them and the army, such and such positions being supposed to be occupied?

In short, every thing that may exercise an influence on the war must be studied with care, and be well known, taking advantage of every detail, and neglecting no opportunity however slight.

Let us now proceed to the reconnoissance of the country it is proposed to invade.

The objects of this reconnoissance are—1st. To obtain information respecting the country in general; 2nd. To prepare such movements as may be required, whether only with a view to pass through the country, or to take up positions with the intention of occupying it permanently; 3rd. To obtain a knowledge of the posts occupied by the enemy, or of those it may be proposed to occupy; Lastly. To examine those parts most suited for the marches and encampments of an army and for fighting, and those which may prove advantageous positions, either with the view of protecting a considerable extent of country, or of advancing into the enemy's; taking care always to look well to the safety of the flanks and rear.

From what has been already said, and from the following remarks, may be seen, what points should be treated of in descriptive military notes, intended to give the result of a reconnoissance.

The Staff Officers or others, who are sent in advance on each of the routes by which the troops are to proceed, should receive along with their instructions, an itinerary of the marches of the troops; and they will conduct the reconnoissance they are charged with, and complete the explanatory notes in the following manner:

The distances from one halting place to another should be calculated by hours; the nature and state of the roads, and of obstacles which might impede or retard the march, such as the passages of rivers and streams should be carefully described, as well as the means of surmounting these, either by making use of the facilities that may be found for constructing bridges where necessary, or of the resources presented by fords, boats, or any existing bridges.

The roads from one halting place to another should be given, and a correct itinerary of them prepared. It is of great importance to know the distances, because this is the only means by which the general movements and those of the smaller bodies can be combined. Where roads are forked or intersected by others, the points to which their branches may lead should be carefully indicated; observing also to specify the distances, and the particular roads leading from one city, town, or village, to another.

The greatest attention must be given to descriptions of the high roads, as well as of those communicating with them, stating for what sort of troops they are suited; that is, whether they are practicable for waggons, artillery, and cavalry, or merely for infantry, the distance being always given in hours.

The villages, country seats, houses, mills, &c., that may be situated on either side of the route to be pursued, or in the same direction, should be remarked. The cities, towns, and villages, which are enclosed, or are defended by castles or strongholds, must be mentioned, as well as their respective distances and positions; so must those posts susceptible of being occupied with or without any preliminary labour, such as churches or churchyards raised and surrounded with walls; every thing, in short, that is connected with encampments and military positions.

Exact information must be obtained respecting each city, town, village, and country seat, as to the States to which the former belong, and the proprietors of the latter.

Some men well acquainted with the country should be sought out, and a note made of those who have the best and most extensive knowledge on the subject: their names and residences should be given, in order that they may be easily found again if required.

The villages destined for halting places should be carefully examined in detail, to ascertain whether they will hold the necessary number of troops, and if any orders have been given, or preparations made, for their reception.

The resources in forage, straw, corn, oats, and vegetables, to be met with on the spot, must be ascertained. It is also necessary to know whether the inhabitants can supply bedding for the soldiers; or if their accommodation can be facilitated by making use of any neighbouring villages or hamlets; and in this case, directions should be given to those whose duty it is to make the necessary arrangements.

Should the Staff Officer making the reconnoissance be accompanied by commissaries, the duties connected with the supply of provisions and of hospital accommodation devolve on the latter; while the former have only to decide where the hospitals are to be formed, and to take care that the commissaries employ adequate means to meet the requirements of the different services. The Staff Officers should in like manner satisfy themselves that arrangements have been made by the contractors, or those furnishing supplies, to ensure the subsistence of the troops.

Should the Staff Officers have occasion to mention any city, town, village or hamlet, river or stream, with a name that might give rise to any difficulty, they should make some of the principal authorities write it in their presence; and should they not be acquainted with the language of the country, each officer must take care to provide himself with an interpreter, so as to be enabled to obtain such information as he may consider necessary.

The Staff Officers should be provided with lists of those quarters on the line they have to pursue, which are to be occupied by the troops, so that while making the reconnoissance, they may at the same time examine them. Notes should be made respecting the carriages of the country; their number and description; and also of the resources to be found in horses, oxen, or mules for transport.

The number of ovens and mills in each place should be noted, and the resources of the country in wood of all descriptions.

Should the officers charged with a reconnoissance find that in consequence of precautions not having been taken, the roads are not in a fit state for the troops, they must at once acquaint the Quarter-master General with the fact; and show how they may best be repaired.

When details of a military position are given, the points of "appui" on the right and left should be carefully specified; as also the villages or posts that may be within the lines occupied by the troops, to the front or rear; the best situations for the cavalry and infantry, as well as for the artillery, the park, the hospital, and other depôts. The bridges, which ought to be constructed or destroyed, must be indicated; the communications to be opened; the earth works or abattis to be made. Lastly, the outlets by which to advance, and the mode and facilities of retreating.

As a general rule, Staff Officers or others sent to reconnoitre a country about to be invaded, should be careful to add any thing that may have been omitted in their instructions, but of which their zeal and intelligence may perceive the advantage.

RECONNOISSANCE OF POSITIONS OCCUPIED BY THE ENEMY.

In pushing forward these reconnoissances, which are almost always made with armed parties, there may be three different objects:—1st. That of obtaining accurate information respecting the position occupied by the enemy: 2nd. That of ascertaining his strength, dispositions, and movements: 3rd. That of forcing him to show his intentions, by attacking the whole or part of his posts, or by merely approaching them.

The use of the troops accompanying reconnoissances of the two first kinds, is to give facilities for attaining a point whence the force and position of the enemy, as well as a considerable extent of ground may be seen.

To obtain satisfactory results in this description of reconnoissance, the strength of the party should be sufficient, not only to drive back the troops occupying the point from which the position held by the enemy may be seen, and his forces estimated, but also to hold their ground until the reconnoissance is completed.

Reconnoissances of the third kind are limited to attacks of posts, and they are classed under this head only on account of the object in view; as for instance, when a post is attacked which the enemy appears anxious to maintain, either because it favours his ulterior views, or because he is about to take up a new position, or is meditating some offensive or retrogade movement, &c.

In enterprises of this description, no greater number of troops should be employed than may be necessary to carry the post to be attacked; and should the enemy return with reinforcements, it must be abandoned, to avoid engaging in a useless combat; for the object of the reconnoissance is already effected, as it is evident from the enemy's efforts to retake the post, what importance he attaches to its preservation.

In attack made on the lines of the enemy's out-posts, whether on the whole extent generally, or only on one point, may be classed as a reconnoissance of the third description.

The number of troops detailed for an attack of this nature, should be estimated with reference to the number occupying the posts to be driven in; and should the enemy return with reinforcements to regain his line, a retreat must be sounded to avoid an engagement which might become serious, and which the attacking party is seldom in a position to maintain.

All reconnoitring parties should move with the greatest celerity, and should retire as soon as their object is attained. It is not enough in this operation, that the dispositions be well combined they must likewise be conducted with ability; and care should be taken during the advance to leave intermediate posts in order to facilitate the retreat,

One of the best modes by which officers can become skilful in the science of military reconnoitring, is by accustoming themselves when travelling, hunting, or walking, to look on everything in a military point of view; that is to say, they should, when so employed, study the directions of the roads; the courses of the streams. They should, in mountainous countries, learn to distinguish the principal chains from the spurs and branches thrown out from them; the sources of the rivers; the general nature of the slopes; the gorges; the depth of the valleys; the distances between places; the points from which the general aspect of an unknown country may be best learned; the points best adapted for making a survey; the triangles and base lines to be projected by the eye, &c. It is by thus exercising their judgement, that officers may attain clearer and more military ideas of a country.

It is not enough that Staff Officers should know how to reconnoitre a country, they must also be accurate judges of ground, and be able to appreciate distances from different points of view. They must be proof against the numerous illusions caused by the different appearances of ground when unoccupied or covered with troops; by the complicated effect of troops of different descriptions seen from different positions; by the manœuvres of these troops; the tactical stratagems employed by them when skilfully handled; by the state of the horizon; and a thousand other accidental and local circumstances.

Moreover these officers should know how to form a prompt and correct opinion of the influence that any given country may have on military operations; of the positions it offers in such and such cases for an army, or any given body of men; of the best approaches and general line of march towards any given point; lastly, of the general bearing that the nature of the country may have on the armies about to act in it, and of all details connected with the subject.

4. *On Marches.*

The object of all marches is to reach some given position, either with a view to its permanent or temporary occupation, or to some ulterior movement.

Before commencing a march, a knowledge should be acquired, by means of reconnoissance, maps, and notes or itinerarie, of the following particulars, viz.

Of the directions of the roads, their length and points of termination; whether they traverse rivers, streams, villages, woods, marshes, plains, valleys, or heights; if they are hollow, and what is their width; if it is the same in all parts; and how many men, either on foot or mounted, can move abreast; whether they are stony or sandy, well beaten or muddy, flat or enclosed, and commanded by the surrounding country. After having acquired this local information, the time necessary to traverse them must be estimated approximatively in hours of march. This knowledge is of the greatest importance, and indispensable for the punctual execution of all movements. It must further be ascertained whether the nature of the ground changes, and to what extent; if the roads may be easily broken up, and if they require repairs; if there are precipices to be encountered, or any considerable ascents or descents; if the roads are practicable in all seasons; and if they will admit of the passage of cavalry, the transport of guns, carriages, &c.; whether they are only fit for infantry, or will answer equally for all arms; whether they are lined with trees, woods, hedges, or ditches; what roads cross or run into them; whether these are good or bad, and to what points their different branches lead.

Those roads only are good in all seasons which are paved, or covered with stones or flints, with gravel or coarse sand. Those passing through stiff soil, enclosed by fences, almost always become bad in rainy weather.

When there is only one road in the same direction, it should be ascertained by examination whether others might not be opened parallel to it, in order if necessary to increase the number of columns, In this case, the routes must be accurately prescribed, and the general nature of the country ascertained.

Secrecy, celerity, and order are in marches the most indispensable conditions.

Without profound secrecy, a risk is incurred of failing in the object in view; for the enemy being acquainted with the motive for undertaking any given march, may prepare counter-movements, and cause the failure of the best concerted enterprise.

Without great celerity, the state of things with reference to which the march was planned, may change; and the slightest delay may render useless and even objectionable a well combined movement that would otherwise have been of the highest importance.

Without order, no march can be conducted with promptitude. When the commanding officer has no longer his troops well in hand, every movement is attended with danger; and should circumstances require any deviation from the orginal disposition, confusion is the result; obstacles become multiplied; and the propitious moment for the execution of the enterprise is often allowed to escape.

In order to perform a march with order and celerity, the troops should be extended on as large a front as their safety and the nature of the ground will permit; they will thus reach their destinations more quickly, and their leader may always be master of his movements.

It is not proposed in this work to lay down principles for the marches of large armies; but merely to point out what rules should be observed in order to conduct properly the marches of corps forming advanced and rear guards, of detached bodies, &c.

All marches are made in one of the three following modes,—to the front, to the rear, or to a flank; in a perpendicular, parallel, or diagonal direction, according to the situation of the point towards which the march is directed, and the position of the enemy.

From the direction of the march, the formation of the corps into one or more columns is determined; and it is seldom necessary to divide a small corps into several; at least it should be avoided as much as possible, particularly if there is any danger of being attacked during the march.

Every facility should be given to enable the troops to execute the march with order and celerity; and obstacles which might cause delay or disorder should be carefully removed.

In a march to the front, each column should be preceded by an advanced guard, whose principal duty is to reconnoitre the ground across which the column is to advance, and to drive from it any parties of the enemy.

In marching to the rear, each column should in like manner be covered by a rear guard, which arresting the pursuit of the enemy, enables the main body to reach its destination rapidly and with safety, or to take up a good position.

In a flank march, as the column may be attacked in front, in rear, and on either flank, it should be covered by a chain of small parties, more particularly on the flank nearest the enemy. This chain need not necessarily be strong, for were the column attacked in front or on a flank, it could quickly and easily show a front to the adversary, either by forming line on the front, or by wheeling into line to the right or left.

The nature of the ground decides what description of troops should form the advanced and rear guards; as well as the distance to be observed between them and the columns.

(It is not out of place to observe here, that the most advantageous formation of a column supposed to be marching at a short distance from the enemy, is that of the "column of attack*;" because this formation readily lends itself, not only to the sure and rapid execution of all other formations that circumstances may demand, but because it is naturally the order of march and of combat; it occupies less ground than the column at wheeling distance, and again it fatigues the troops less than the close column.)

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* The order to form troops in "columns of attack" by battalions is often misunderstood; some Generals deploy the battalions in rear of each other; but the real meaning of the order is, that the battalions should form columns of grand divisions at section distance on the two centre companies. Jomini, Vie Pol. et Mil. de Napoleon, vol. iii. page 273.

In an open country the advanced and rear guards should be composed entirely of cavalry; this arm, being able to go to a greater distance from the main body than infantry without committing itself, can observe more closely the movements of the enemy, and can retire more rapidly. Cavalry scouts should be pushed to considerable distances, more particularly in flat and open countries where the enemy having no obstacles of ground to contend with, might advance with great celerity, and fall on the main body before they were aware of his approach.

When the nature of the ground is such that it will not suit either for cavalry or infantry alone, the advanced and rear guards should be composed of both arms, so that they may afford each other mutual assistance; and in such a case, they ought not to go so far from the main body.

In a very broken country, or one so mountainous that cavalry would be useless, infantry should be detached both in front and rear, but without going too far; because in this description of ground there are defiles at every step where the enemy might lie in wait, surprises and ambuscades being easily planned. Ground of this description should be examined with the greatest care; bearing in mind that if it is favourable to the march of a retreating column, it also renders movements in advance very slow and difficult; and should be entered and traversed, so to speak, with the "lead going."

The distance to be preserved between the advanced or rear guards and the main body, according as the march may be towards the enemy or the reverse, should be neither too great nor too small; and the force employed should always be proportioned to the main body.

Although the strength of an advanced or rear guard, as well as the distances to be preserved between them and the main body, can only be fixed approximatively, still the following data may assist in deciding on these points; 1st. The strength of an advanced or rear guard should be about a fifth of that of the main body; and 2nd. The greatest distance which should be allowed between advanced or rear guards and the main body, supposing the latter to consist of about two thousand men, is a thousand paces. Were the strength of these guards more than a fifth, the main body would be too much weakened: were it much less, they would not be able to withstand the first onset. In like manner, were the distance between the guards and the main body more than a thousand paces, they might be beaten before the latter could arrive to succour them: but again, were the distance much less, the enemy by attacking suddenly the advanced or rear guards might reach the main body before it had time to make the dispositions necessary to receive him.

The nature of the ground, the different descriptions of troops to be employed, and the different circumstances that may occur, and which cannot always be foreseen, are so many considerations which decide how far the rules just given may be modified.

In an open country, the greater part of the cavalry may be placed at the head of the column. Should the nature of the ground be varied, it must be divided, one half in front and the other in rear; and in a very broken country, it should march behind the infantry. As to the artillery, it should be placed in the intervals of the column. It is only in countries much intersected that the greater portion of it is placed in rear of the infantry; and in this case, the latter should cover the artillery by means of parties attached to it.

The advanced and rear guards should only have with them pieces of small calibre, and but very few of them if the country is very rugged.

We may observe, however, that there are cases where the advanced guard of an army should be provided with field pieces of the largest calibre; as for instance, when it is already on the ground where the general proposes to give battle. In this case, it should be able to keep the enemy at such a distance, that his projectiles may not reach the columns until they are in a position to advance on him: but these are exceptions.

The advanced guard of a division marching on a high road in an open country, may easily arrest the progress of an enemy coming directly towards it and may thus enable the corps to make its dispositions for attack or defence: but not so in a mountainous country, where the roads practicable for columns generally follow valleys, which debouch either in a plain or in other valleys running in directions entirely different. Valleys at a distance of several days' march from each other, often have communications not only by roads but by paths which traverse the sides of the mountains, and follow all their windings.

In such countries the advanced guard alone, would not be sufficient to cover the corps which it precedes, from attacks of the enemys' detachments, which sallying from the neighbouring valleys and climbing the heights on either side of the road, could pour on both the advanced guard and the column, a well directed fire, which would not fail to carry disorder and destruction through their ranks,

An advanced guard not being able to extend its front in a mountainous country as in open ground, so as to prevent the main body from being turned or unexpectedly attacked in flank, and being also unable to occupy all the passes leading to distant valleys, sometimes many miles from its route, it is necessary, in conducting a march through a country of high mountains, that the main body be not only preceded and followed by an advanced and rear guard, but also, to ensure its safety, that parties of infantry be detached on its flanks, covering them by marching in a parallel direction along the summits of the mountains which enclose the valley where the main body is advancing.

This precaution which is indispensable, is the only one which affords the means of securing troops from unexpected attacks while traversing valleys, or following the roads and paths which cross them.

It is not necessary that these detachments should be composed of a great number of men; because small bodies can act better in countries abounding in high mountains. They should not keep further from the main body than is necessary to enable them to occupy the heights from which the enemy might harass the march, and they should be sufficiently near to be supported in time. Neglect of this precaution, particularly in mountain warfare, has often caused the loss of the best troops, and occasioned the greatest reverses.

Night marches should be made only in the most urgent cases; because, in the first place, the men cannot be seen in the dark; secondly, because such marches favor all sorts of disorders; and thirdly, because they are opposed to that celerity which is so necessary and valuable in the execution of military operations.

When an open attack or a surprise is contemplated, the advanced guard should be at a short distance from the head of the column, so as not to alarm the enemy too soon. In such cases, the patrols that may be sent forward to reconnoitre the route should not be pushed too far.

The advanced guard being brought nearer, it is true that the officer commanding the column sacrifices some of the advantages of marching in security, but he should compensate for that; 1st. By increased vigilance; 2nd. By covering his front and flanks with small flying patrols; 3rd. By making his troops march in the highest possible order, and in silence, so as to secure himself from surprises as well as to be in a condition to act successfully should anything unforeseen occur.

When from the nature of the ground, it becomes necessary to divide small bodies of troops into several detachments; as for instance, when the object marched against can only be reached by combined movements from different points; or again, when the advance along a high road can only be conducted in safety after the cross roads or some neighbouring positions are secured; in either case, it is necessary above all, 1st. To be thoroughly acquainted with the ground on which it is proposed to act, as well as with that which surrounds it; 2nd. To make a prudent division of his force; 3rd. To know how to employ the time to the best advantage, making all calculations beforehand; and 4th. Not to detach from the principal column, or to employ in the formation of the others, more than the number of men, horses, and guns considered strictly necessary to effect the object proposed.

The columns should always be in communication with each other, and sufficiently near to afford mutual support. In an open country, they ought to march in such an order as to be able at the first word of command to form up quickly and in the best manner. With this view the heads of the columns should march in line, and the respective distances between the different columns and between the companies should be strictly observed. The nature of the country and of the roads, the destination of the troops, the presumed disposition and intentions of the enemy are considerations which should determine what description of troops may be best employed on the different points, and in what manner.

The artillery and baggage should not leave the practicable roads until absolutely necessary. Cross and hollow roads, ravines and forests, are only suitable for infantry; as are the plains for cavalry.

The three arms should cover and protect each other mutually, so that each may be able to deploy and make the best use of its peculiar advantages, and that all may be equally disposed and simultaneously directed towards the same object.

To these principles may be added another which should never be neglected, and which applies equally to an army as to a strong detachment; it is this, that the order of march may be such as to become the order of battle, by a few short, rapid, and simple movements.

This is the principle to follow, and not that which is given in many military works, viz:—" that a march should be conducted in the order in which it is intended to fight;" a false principle if not properly interpreted, or at least very equivocal, and consequently calculated to lead into error; for as the country which an army traverses in its march is generally different from that in which it would encamp or give battle, unfortunate results might occur were the same dispositions applied to two operations totally different, and to one of which they could consequently but rarely be applicable.

It could be only in traversing a country of exactly the same nature as that in which a camp would be formed, such as an open plain, that it would answer to march in the order of battle; but this would be a peculiar case, and an exception to the general rule.

The order of march is always subject to frequent variations, because it is and always should be dependent upon those of the ground; for example, should the route pass from a country of plains to one covered with mountains, and from this latter to a close country, intersected by marshes and woods, surely the infantry, cavalry, and artillery ought not to be distributed in the same manner, but according to circumstances and the nature of the country.

5. *On Skirmishing.*

In warfare, the main object in planning the order of battle is, to obtain, by the union of forces, and by prudent combinations in employing them, decisive results, whether acting offensively or defensively.

This object being of the first and most essential importance, the order of battle best calculated to effect it is the only one worthy of consideration. All other dispositions should be looked on as accessory to it.

But to facilitate the execution of this order, those obstacles should first be removed which might cause delays at the decisive moment of action.

It is with this view that an army acting offensively is preceded by an advanced guard, whose principal duties consist in reconnoitring the country which the army has to traverse, in covering and securing its march, in beating and driving back the enemy's posts, and in seizing his positions; in short, it is by the well directed employment of this advanced guard that the army is enabled to execute its movements with equal order, precision, and security.

Should the advanced guard approach a point which can only be carried by the assistance of the main body, it halts, takes up a position while awaiting the arrival of the columns, joins them, and if successful, resumes its former employment, pursuing the beaten enemy; but in case of a repulse, it will form the rear guard and cover the retreat.

When the army is in position, the advanced guard occupies the advanced posts, which cover and protect the army from surprises. Those positions are selected whence it may the most easily arrest the progress of the enemy in time to enable the general to ascertain and judge of his intentions, and to prepare the best means of resistance or of attack.

These dispositions, based on the nature of things, have been constantly followed, both in ancient and modern times; and the war of the Revolution has not introduced any essential changes, either in tactics or strategy; it has only added a new method to those already practised in preparing for the principal engagement.

In the early campaigns of the Revolution, the French army was formed in part of citizens hastily assembled, who had not received any military instruction, nor were they accustomed to war. The leaders could not hope with such troops to oppose an effective resistance to manœuvring armies. The danger was pressing; France was attacked on all sides; it was necessary to find some means of counteracting the immense advantages possessed by the enemy, as much from the good organization of their armies, as from their discipline compared with that of the French army at that period.

A new system of fighting was introduced. This system consisted in the calling into play a considerable number of skirmishers—and to that France owes, in part, her early successes.

During the first campaigns, when an army was to be attacked, or a position defended, a part of the battalions detached as skirmishers performed in front of these battalions the duties of an advanced guard at the commencement of an attack, sweeping the enemy from the whole front; and, in the same manner, these detachments formed in skirmishing order and dispersed along the front of their battalions, commenced the onset by a well directed fire, which annoyed the enemy, shook his ranks, and thus weakened the resistance which he might otherwise have offered to the masses or the advancing lines. So much for the attack: now for the defence.

When the enemy, after having forced the line of advanced posts, approached the position occupied by the army, a cloud of skirmishers thrown out in front of this position often succeeded, by the efficiency of their fire, in putting a considerable portion of their adversaries "*hors de combat*," carrying disorder into their ranks, and often forcing them to abandon their undertaking.

Thus the objects proposed by the enemy's generals miscarried; the attacks of posts were repulsed, or important posts were abandoned. The enemy's lines thus exposed to a fire of skirmishers, were quickly thrown into disorder from the losses they suffered; they broke their ranks, and the loss of the battle followed; or if it happened to be gained, it was no longer in consequence of the first dispositions, for these not having been carried out, it became impossible for the enemy's generals to re-establish the original order, or to direct, in the heat of action, the movements of a disorganized army.

This novel mode of fighting practised during the early campaigns, and against which foreign armies had nothing to oppose but their tactics, was one of the causes which contributed in a great measure to the advantages which the French obtained at that period.

This was not the only consideration which induced the European armies to adopt, generally, the system of skirmishing; there was another, and that an important one.

As long as battles were only fought in lines deployed and contiguous to each other, or in masses, broken ground, obstructed by ravines, marshes, or by thick forests, appeared impracticable, these being only used as points on which to rest the wings of an army; and ground intersected by ditches or hedges was not occupied, because it was presumed that the enemy's columns could not penetrate it; but the light infantry system diminished these obstacles; and until generally adopted, he who put it in practice had all the more advantage, inasmuch as ground is more frequently broken, than flat, open, and uninterrupted.

But the rules to be observed in the employment of skirmishers, as well as in their formation, depend on the causes which have rendered them necessary, as well as on the advantages and inconveniences resulting from this mode of fighting. Moreover, the fact must never be lost sight of, that bodies of skirmishers, although intended to prepare and facilitate the means of dealing the principal blow, are not themselves to deal it; consequently, their numbers must be limited so as not to weaken too much the main body, indeed, they should never exceed at most a third of the whole force.

Detached bodies should never be entirely dispersed in skirmishing order, they should keep a reserve or nucleus, which may support and relieve them, and on which they may rally in case of a check, so as never to be obliged to apply to the line of battle for assistance. This precaution is the more necessary, inasmuch as isolated men could not carry the smallest post; and again, skirmishers unsupported by any reserve, run a risk of being thrown back on the line by a brisk attack of cavalry—such retrograde movements often causing disorder.

The chain of skirmishers should never be too far from the line of battle, not only that they may be able always to fall back on the latter without committing themselves, but also in order that the skirmishers who commence the action may be always within reach of the troops who are to decide it, otherwise the success which the former might have obtained would be useless if the enemy, after his skirmishers were driven in and his first lines shaken, had time to re-establish order in his ranks.

The nature of the ground must decide in what manner the light infantry is to be distributed, and where the reserves ought to be posted.

These reserves are too weak to have any real consistence; they are only intended, as has been already said, to rally and support the skirmishers in case of need. They should, consequently, be so posted as not to be too much exposed to the fire of the enemy, and to be able easily and promptly to support, relieve, and rally the chain of skirmishers as a whole or in any particular part.

Acting defensively, light infantry reserves should occupy not only the most advantageous points, and those where they may offer the longest resistance to the efforts of the enemy, but moreover, those whence they may be able to do him as much harm as possible; the points to be occupied, for instance, are the back of a dyke, a hedge, a wall, a ravine, an undulation of ground, trees, &c.

In the formation of those bodies destined for reserves, the same rules should be observed as are applied to the formation of those acting as skirmishers.

The strength of the reserves should be proportioned to the degree of resistance of which the post may be considered capable; but in any case the reserve should never be less than one fourth of the corps of skirmishers. The greater the strength of the reserve, the more resources it will be enabled to offer at the decisive moment.

In broken ground, where the attack is less vigorous, the strength may be reduced to a fourth, whilst in a flat and open country it should be at least one third. The body destined to act as light infantry should be divided into three parts,—the first forms the reserve; the second placed in front of it is destined to re-inforce and relieve the skirmishers; the third extended in skirmishing order is in front of the second. This part covers the whole line, and there are circumstances where it should be formed rank entire.

The object in skirmishing being to shake the enemy by a dropping fire, the men should never remain in close order, but should open so as always to leave between each file an interval of several paces—six at the least; thus, fifty men will suffice to form a chain which will not only cover a battalion of 720 men, formed in three ranks, but will outflank it by ten yards, the extent of front being only 140 yards. This rule must always be attended to in the formation of a line of skirmishers, which ought to cover the front and overlap the flanks of the corps before which it is placed.

However, it is only from a knowledge of the ground that it can be properly decided whether the chain of skirmishers should extend along the whole, or a portion only, of the front; whether it should be stronger on one point than on another; and also, what movements it should make, whether in advance or retreat.

Every manœuvre made in the vicinity of the enemy, should be covered and flanked by light infantry, whether the object of the manœuvre be to form the troops from line into column or from column into line.

The defence of points, of which the occupation is rendered indispensable by the position of the army, should not be entrusted to skirmishers, but to strong detachments of infantry, which establish themselves at these points while the army is taking up its position. The skirmishers should only be thrown forward immediately before the action.

When the skirmishers (placed in front) are obliged to retire before a superior force, they should fall back on the reserve, and afterwards join the main body along with it. If, on the contrary, they are in pursuit of the enemy, they should never go beyond the point where they may be ordered to stop, for were they to give themselves up inconsiderately to the pursuit, the enemy might, by a feigned retreat, draw them into an ambuscade, and this would be the more felt, as it would weaken the number of troops destined to defend the position conjointly with them, and might suffice to cause its loss.

When the skirmishers can no longer hold their ground, even with the aid of their reserves, they must not be reinforced at the expense of the line of battle, for we may conclude that if the enemy employs a sufficient force to oblige the skirmishers to abandon a position which is closely connected with that occupied by the main body, or even independent of it, but within reach, he will not rest satisfied with driving in the skirmishers solely to possess himself of a point under the fire of the principal position, where he could not maintain himself, but, rather, that he intends marching directly on the position itself.

Supposing that in such a state of things, the corps acting on the defensive were to divide itself into skirmishing parties to dispute the ground in front, what would happen? Should the enemy remain in masses, he will certainly have but little difficulty in breaking the line of skirmishers at some point, and will reach the position without encountering any opposition.

But if the skirmishers fall back in time on the line of battle, before the enemy has been able to sweep off any portion of them, then their forces may be better employed at the decisive moment. What has just been said in relation to the course which skirmishers should pursue when defending a position, is equally applicable to them when acting offensively.

When opposing lines approach sufficiently near to attack each other at once, the skirmishers should uncover the front of the line and move towards the flanks, in order to act in concert with the main body.

Every body of men which keeps itself compact will always break through a line of skirmishers, because, when men are scattered, unsupported, and uncovered on the flanks and rear, their means of resistance consisting of a few musket shots, they cannot maintain their ground like masses or lines which, by their dispositions, support each other.

This is the reason why skirmishers should endeavour to find, in the nature of the ground, some compensation for the advantages which they lose by their mode of fighting, whether in attacking or defending a position, or in covering a flank march. They should in these different cases know how to select posts whence they may, from under cover, annoy the enemy and do him as much harm as possible, taking care never to separate themselves too far from the corps they precede or follow.

The mode of employing skirmishers should always depend on the nature of the ground acted on, and should have reference to the dispositions of the adversary.

For instance, if in an open country a corps has nothing but infantry with which to oppose an enemy who has both cavalry and infantry, it would be dangerous to call into action (on such ground) skirmishers, who would soon be driven back on the line by a charge of cavalry, where they would cause disorder, giving the enemy an opportunity of attacking the line with success,

In an open country, where infantry is acting against infantry, and where undulations of the ground are to be found, skirmishers are very useful; nevertheless, they should not be employed in too great numbers, nor at too great a distance from the main body, otherwise they might expose themselves to be cut off. In such ground, troops can only act with advantage in line or in mass.

The more the ground is broken, the more it is suited for skirmishers, because, favoured by ravines, dykes, ditches, hedges, woods, and buildings, they can keep up their fire for a long time before the enemy, impeded by such obstacles, (and other local difficulties,) can manage to dislodge them.

Skirmishers can never be employed more usefully and advantageously, than in ground of this description, where the deployment of columns is impossible, or at all events, very difficult, and they often find themselves obliged to separate in order to avoid the obstacles which obstruct their movements; whether the columns are in position or on the move, the skirmishers may easily succeed in breaking them, without sustaining the slightest loss themselves. However if, notwithstanding the difficulties of the ground and the well directed fire of the skirmishers, the columns still continue to advance, then the skirmishers must fall back on their reserves, which should always be within reach in order to support them.

If, notwithstanding the junction of the skirmishers with their reserves, the enemy still obliges them to retreat, they should make a stand behind every obstacle which the ground may present, and dispute them all vigorously before they fall back on the main body.

When the enemy is on the line of march, and skirmishers are sent out to harass him, they should ensconce themselves behind hedges, palisades, and buildings, in short, behind every description of cover from which they may best annoy and obstruct him. They should keep up a brisk fire on his front and flanks, retiring if he advances in force, and resuming their position should he recall the detachments sent against them.

When the advance is made with the intention of attacking the enemy, and skirmishers are sent on to commence the action, their chain should be formed beyond the range of the enemy's musketry.

In an open country, skirmishers should march as much as possible in line, in broken countries the line should conform to the inequalities of the ground.

Skirmishers ought rapidly to clear any open spaces, in order to gain some advantageous point, whence they may keep up a fire without being too much exposed ; and after some rounds, they should again move forward and occupy other points equally favorable.

When the skirmishers who are most in advance fall in with positions, where the enemy is established in force, they should halt and keep him engaged until others coming up join them in dislodging, turning, and making him uneasy with regard to his flanks, until the reserves come up to force the position.

When the skirmishers have driven the enemy from his advanced posts, and have arrived at a short distance from his line of battle, they should disperse themselves behind the nearest hedges and ditches, and keep up without ceasing a vigorous fire on the line, until the mass of the main body has joined them and has commenced the action.

The rules to be observed by skirmishers when advancing, should be equally observed when they cover a retreat.

Whenever skirmishers are obliged to retire, they should halt at every point whence they may deliver their fire with advantage, facing the enemy if he pursues them closely; but taking care not to remain too far in the rear of the corps whose march they cover. To enable the main body to gain some advantageous position, it may be necessary for the skirmishers to make a stand at some particular point, and oppose to the efforts of the enemy a longer resistance than is prescribed by the usual rules. In such a case, the reserves, whose only object during a retreat is to support the skirmishers at the most important points, should halt with them, and take an active part in the defence of the position where the skirmishers are making a stand; still a portion of the reserves should always remain together, so as to give support to those parties that may stand most in need of it.

When skirmishers, in traversing open ground, are in danger of being attacked by the enemy's cavalry, they should close, form in one body, and in this order rapidly gain the broken ground, or some favourable position.

When skirmishers arrive in front of a defile, which presents only one or two passes, whether guarded feebly or in strength, they should, in the first instance, penetrate by main force, whilst other skirmishers support this attack by keeping up a fire from points flanking the defile; and as soon as the passes are forced, the reserve should run forward, debouch, deploy, and occupy them, until the approach of the column, when it rejoins the skirmishers and follows anew their movements.

Should the passes be occupied in force, the skirmishers must disperse themselves along the edges of the defile, and keep up a sharp and well sustained fire, until the arrival of the reserves, or even of the main body; when the reserves should unite and simultaneously with the skirmishers who crown the defile, attack the point to be forced.

The defile being forced, should circumstances require the skirmishers to be pushed on further, the reserves continue to march in support of them. The rules above given as relating to the passing of a defile while advancing, are equally applicable to the retreat.

For example, when, in passing through a defile retreating, the pursuit of the enemy is not too close, the rear guard should establish itself at the most advantageous points covering the entry of the defile, and should make every effort to prevent the enemy from penetrating until the main body has passed through, or is sufficiently advanced not to be overtaken by him in the defile itself, whatever diligence he may use; the rear guard may then leave the points it had taken up, and continue its retreat; whilst the reserves of skirmishers, deployed and thrown out to the right and left of the defile, should defend the entry. As soon as the main body and rear guard are clear of the pass, the skirmishers and their reserves (of which a certain portion flank the defile,) should form in sections, and follow the rear guard at a distance of from two to three hundred paces.

Whenever the enemy pursues his adversary vigourously, the passage of a defile (on the retreat) should be conducted as above directed; but as the skirmishers and their reserves must not be sacrificed by being abandoned to themselves, detachments should be posted at the outlets of the defile to remain there until the last of the skirmishers have cleared it.

In the attack and defence of forests, skirmishers should observe the same rules as those applicable to broken ground. In forests, in place of hedges, ditches, and buildings, they are covered by trees, brushwood, and inequalities of ground, which enable them to give their fire with advantage; but as in such situations the officers cannot see what takes place at a distance from them, they should devote the greatest attention to preventing the men from straggling and losing sight of each other; and should make them preserve, as much as possible, their alignment as well as their communications. In such ground, it is better that the shirmishers advance more slowly than that they should not march together; for any opening or interruption in their line may be attended with serious results; the enemy might, without being perceived, pass through the line, cut off and defeat one part, without the other part being in the least aware of it.

Skirmishers can never be more usefully employed than in a country of high mountains, where the war is generally confined to affairs of posts; for although in mountainous countries the only roads practicable for corps with waggons or other carriages are to be found in the valleys, still there is no mountain so inaccessible that a few men may not find paths by which to climb its heights, or across which small bodies of troops may not be sent.

The following principles show how skirmishers should be disposed and made use of in mountain warfare, as well in the attack as the defence.

In countries abounding in high mountains, skirmishers, at the moment of attacking a position, should be detached on the heights on both sides of the valley, where the enemy may be. They should gain the eminences successively, and march so as never to pass each other. If they succeed in driving back the enemy, either by main force, or by threatening to turn him, and he effects his retreat by paths across the rocks, then the skirmishers must pursue, whilst others seize points on the heights from which they may with the greatest possible advantage direct their fire on his position, and thus favor the attack which the main body is making in the valley.

Should the skirmishers, after having dislodged the enemy, find any paths leading to his rear or flanks, some should follow them in order to alarm and render him uneasy, whilst the greater number join in the principal object, which is to force the position.

When, in order to dislodge the enemy from mountains, it is necessary to be master of the summits, gorges, and of all the elevated points, so as to take him both in flank and rear, the nature of the ground obliges us to employ small detachments, which must march in skirmishing order by any paths they may find. They should advance slowly, and reconnoitre all passes attentively. Their reserves should post themselves on the points where several paths cross, and more particularly on those by which, in case of retreat the skirmishers would have to retire.

When, in mountainous countries, the skirmishers are advancing, and have arrived in sight of an enemy's post they should separate, and take up such positions as will enable them to attack it from several points at once; and should they perceive on the heights which command the post any point whence they may take the enemy in flank and rear, they should at once make for it.

When, acting on the defensive, in a mountainous country, a position is taken up at the entry of a valley, or in the valley itself, the summits of the surrounding mountains should always be occupied by posts, which, in case of attack, will form and act as skirmishers.

It should be observed that every defensive position in a valley is taken up with reference to the strength of the body which has to defend it. Such a position is selected either behind a narrow pass, in front of which the enemy, before he could commence his attack, would have to form under a fire directed on him from several points, or else in the pass itself. In either case, the flanks of the position would rest against the mountain; and, to ensure the safety of these flanks, the heights to the right and left should always be held. This position should be occupied in such a manner as to allow of taking the enemy in flank, if he makes a front attack, without, however, endangering the safety of the point against which his attempt is directed.

To effect this, detachments must be sent out, which, climbing the neighbouring heights, crown them with skirmishers. These should be so placed as to be able under cover of rocks, trees, &c., to direct a deadly fire on the enemy. A small reserve should hold the heights, and the paths by which the skirmishers would have to retire, if forced to retreat.

The skirmishers should occupy and defend the rocks, the mountains, and the paths, across which the enemy's detachments might be able to gain the highest points, whence they could easily attack the flanks and rear of the position.

The commander of a post placed amongst mountains should always keep his reserve on those points where several paths cross, and more particularly on those where he may be able to make head for the longest time against an attacking enemy.

Detachments of skirmishers occupying mountains should only remain there so long as their retreat is secure; otherwise, when they see that the enemy advances with superior forces, and threatens to intercept their communications with the main body, they should retire from their posts, being guided as much as possible in their march by the movements of the main body, and taking care to preserve such a relative position as to cover and protect it by their fire.

Should the enemy take the skirmishers in flank, and they find themselves unable to make head against him, even with the assistance of their reserves, they must retire; but still sufficiently slowly to give the main body which is in the valley time to retreat, or to make such dispositions as circumstances may require.

When the officers who are charged with the direction of the light infantry in a mountainous country know how to employ simultaneously, or by turns, valour, prudence, address, and audacity, they almost always constrain their adversary, even when superior in numbers, to yield, not only the posts established in the valleys, but also those situated on the heights.

The employment of skirmishers is applicable not only to operations which take place in the field, but also to the attack and defence of places.

In the attack of places, the skirmishers should establish themselves in front of the parallels, hollowing out circular pits in which to obtain shelter from the fire of the place. In these small preliminary works, the skirmishers should be directed by officers of the engineers with reference to the defilade of the guns, and should be assisted by sappers, in order the more promptly to obtain cover.

The skirmishers should form a cordon in front of the trenches, which, in case the enemy making a sortie, would remain only long enough for the line to be made aware of the movement, and to take measures to meet it; the artillery of the place diminishing its fire, as the sorties approach the parallels, the skirmishers can easily effect their retreat, and put themselves under the protection of the troops of the trenches, combining with them in their movements, whether they advance to repel the sortie, or confine themselves to the defence of their lines.

The skirmishers placed in front of the trenches are useful, not only in covering these trenches, but also in protecting and covering the reconnoitring parties. It is from these points that the officers of engineers first examine the exterior of places, and then starting from them at night make a closer reconnoissance. Following their example, those who command the skirmishers should attentively examine all the details of the ground, in order to continue their advance in the most favorable direction in front of the parallels, according as these are established.

Trenches are opened during the night. It is also during the night that detachments of skirmishers conducted by engineer officers form the small post above spoken of, where, secure from the fire of the place, they may observe closely any movements which may be made at the out posts, the posterns, the barriers, or behind the glacis, and may acquaint the officer Commanding the troops in the trenches with them, by means of signals agreed on beforehand, which method is far preferable for this purpose to that of communicating by orderlies, the latter being too tedious and often dangerous.

The skirmishers should not confine themselves to observing the enemy from these points, but should annoy him and cramp his movements by occasional shots, and drive from the glacis any of his skirmishers who may show themselves there. It is above all, on any barbette batteries that may be established, that their skill may be exercised in picking off the gunners attached to the service of these batteries.

As the attack advances, and while it is possible to keep pace with it, the skirmishers should continue to keep down the fire, not only of the advanced works, but of the body of the place; and by taking good aim through the embrasures, they may, if they do not entirely stop the fire, at least slacken considerably that of the heavy artillery, wound-ing the men, and rendering the service of the guns difficult and dangerous.

It is evident how usefully skirmishers may be employed in regular sieges, from the first investment of a place to the moment when the breach is 'practicable,' and the assault is about to take place. They then assist by clearing the breach and the neighbouring parapets by a brisk and well directed fire from the last approaches they have been able to establish.

In the defence of places, the skirmishers should occupy all the small works in front of the glacis; and one of the best maxims being, never to yield or evacuate any post until forced to do so, these small advanced works should be defended with obstinacy, and retaken whenever it is possible.

To ascertain when the enemy first breaks ground, and the direction of his trenches, is another duty reserved for the skirmishers in front of a place.

From the first period of the investment, the skirmishers should be constantly patrolling round the place. A patrol may easily cause disorder and confusion in the line of the trenches, more particularly when acting against troops inexperienced in such work; and at all events, the fire of the skirmishers on any workmen they may fall in with, will always serve as a hint to the artillery of the place, and give them a point on which to direct their light-balls.

In sorties, the skirmishers should act as in attack and retreat; in short, it is for them to ascertain whatever is going on, and to accompany every expedition made in the neighbourhood of the place, whether before or during the siege.

It is thus that skirmishers were employed in the attack and defence of Ecluse, Nimeguen, Kehl, Genoa, Dantzic, and of many other places where they rendered good service.

Officers who read attentively the accounts of these sieges, some of which are very remarkable, will find many curious facts and instructive examples.

6. *Attack and Defence of Forests.*

Countries covered with forests are not every where impenetrable, although they are easily defended by means of abattis and field works, and by occupying positions which command the approaches.

Extensive forests are often considered as obstacles to the movements of armies; but in examining them with attention, they will be found not only practicable, but even susceptible of being made favourable to operations. Our last wars offer more than one example of this.

Before occupying a forest which is to be defended, a preliminary reconnoissance should be made.

In order to conduct this reconnoissance properly, a tour of the forest must first be made; the roads, the ravines, and the streams proceeding from it, must be examined; whence they come, and where they go. If considerable, they should be traced up to their sources, and notes made of the roads that cross them, and of the marshy places through which they pass.

The woods must then be penetrated; and their relative situations examined, as well as their extent, and the trees of which they may be composed; that is, whether they consist of underwood or copse; whether they are open or close, partially or entirely practicable, for troops of all descriptions, and for artillery. The facilities of traversing them must be taken into consideration, and of making them conduce to the attainment of the proposed object. Can they be turned entirely or in part? Do the different masses form openings equally wide throughout, or are they narrowed in certain parts? What is their extent, and what the nature of the woods on the right and left? Which are the points where the openings present the largest spaces? The nature of the ground in the forest must be taken into account; and it must be observed whether it is flat or hilly, dry or swampy, and to what extent. Should there be any marshes, ponds, or other important objects worthy of remark, their dimensions must be determined, and their distances from the borders of the forest.

It must be ascertained whether the forest is traversed by rivers, streams, or ravines; what are its roads and paths; where the latter commence and terminate; whether new roads can be easily opened, or the existing roads enlarged, if necessary; what will be the best direction to give them, so that the enemy may not be able to make use of them to throw himself on a flank; lastly, the quality of these roads and paths must be taken into account, as well as their conditions in the different seasons.

It should be known whether within the precincts of the forest there may be any villages, houses, country seats, cultivated grounds, or meadows, and the distances of all these from the borders of the forest; also what cattle it may contain.

If a forest is to be attacked, it should be ascertained whether it can be turned; whether the enemy has prepared abattis, ditches, or entrenchments; and which side presents the least difficulty, and may the most conveniently be attacked.

It should be ascertained whether, after the forest is gained, it can be turned to greater advantage than when in possession of the enemy, either by making use of the thickest cover, or by forming strong positions by means of abattis; lastly, what may be the nature of the ground on either side of the forest, and what positions it presents.

It is dangerous to establish a body of troops in a forest; but when from particular considerations it becomes necessary, every advantage presented by the ground and the local objects should be made available; such, for instance, as country houses and enclosures, which should be loop-holed; above all, the troops should be posted in the most favorable positions, where they may rally and protect the chain of skirmishers and their reserves; in short, all possible means must be practised to make the enemy pay dearly for every step.

The method of defending forests is based on the principle, that the borders should be occupied, whence the enemy advancing in the open ground, may be fired on from behind the trees and hedges.

In occupying the borders of forests, reserves should be kept behind the most important points, whether with a view to maintain the position, or to ensure a safe retreat in case of failure.

In open forests with low underwood, troops should be disposed according to the usual rules; when they are dense and the undergrowth is high, and more particularly when the troops are few in number, the borders should be lined with skirmishers, who, posted behind trees, hedges, and ravines, render the approach more difficult to the enemy.

Behind these skirmishers should be placed the rallying posts, and in rear of these one or two principal reserves.

The strength of the rallying posts must be proportioned to that of the line of skirmishers occupying the border of the forest. These posts, which should generally remain in compact bodies, are intended to relieve and rally the skirmishers and to support isolated points.

The principal reserves should, if possible, occupy a central point, equally distant from all those threatened, but more particularly a point from which the defence may derive the most efficient support; or else one on or near the route by which the retreat would have to be conducted. This reserve has another useful object; it may attack the enemy in a body as far as the ground will permit, should he have penetrated the forest; and if not able to stop him, it will at least serve to protect the routed troops, by covering their retreat.

In the defence of forests, the points to be guarded with the greatest care are the salient and re-entering angles, and the hollows, and ravines by which the enemy might advance under cover; commanding heights; those points where the principal passes cross, and which might be easily turned; in short, every point which would give the enemy an opportunity of attacking under cover.

It is sufficient to place small posts on the other borders of the forest to preserve the communications, and prevent the enemy from penetrating, unobserved and without opposition.

When the enemy is weak or commits himself, as, for instance, by making his attack in disorder, and without having his flanks covered or resting on any obstacles, the rallying posts and principal reserves should in either case, and according to circumstances, attack with the bayonet, keeping always united. In such attacks small detachments of cavalry are very useful in seconding the efforts of the reserves.

There are cases where the advancing enemy should be attacked in the first instance with the fire of the skirmishers alone. These, posted along the borders of the forest, retire slowly on the reserves, keeping up their fire; but afterwards return to the attack with the rest of the forces. This manœuvre should be executed more specially when any wavering or hesitation is perceived in the enemy's line, owing to the fire they have just experienced, or the difficulties of the ground.

In order to make a more efficient defence of a forest, when the time permits, abattis should be constructed, epaulments thrown up, and trenches dug: the defenders being under cover, the attack will be rendered more difficult; and the artillery being more advantageously placed, will of course produce a greater effect. In such a case, the dispositions of the troops will remain the same; but the chain of skirmishers on the borders of the forest may be strengthened; then the rallying posts being less numerous may be more concentrated in proportion to the obstructions which may have been prepared beforehand for the enemy, whether, as has been already said, by means of walled enclosures well loop-holed, or by disposing the troops in such a manner as may enable them to take the assailant in flank and rear, should he make a rash advance after having driven in the chain of skirmishers placed in the first line.

In the attack of forests, every advantage must be taken of local peculiarities, and of any faults that may be committed by the adversary, in the disposition of his troops on the ground he wishes to defend, (these principles are applicable to every description of attack) such, for instance, as a height commanding a forest, but which has not been occupied, salient angles neglected, passes unguarded, lines of skirmishers unsupported, an exposed flank, an advantageous position unoccupied, or openings apparently difficult to traverse, with but little or no protection from abattis. Such are the principal points which must indispensably be taken into consideration in the attack of a forest, and which should engage the attention of the officer entrusted with the operation.

When the most favorable point for the attack has been decided on, the approach should be made as much as possible without being perceived, and the attention of the enemy diverted by false attacks; he should be engaged on these points, while the principal and true attack is carried on rapidly without any hesitation, and executed with the greatest vigour; many men might otherwise be lost, and it would probably fail. The first success must be followed up by a rapid pursuit, so as to give the enemy no time for consideration; for were the pursuit relaxed, he might by means of his reserves, succeed in wresting the advantages at first obtained.

The first attack should always be made with promptness and impetuosity, without obliging the men to keep their ranks; this attack should also be supported by the troops advancing *en masse* in rear of the reserve; the first detachments that penetrate the forest should form a chain of skirmishers, under the protection of which the reserves and the main body advance.

When the nature of the ground does not permit of the enemy's defensive positions being ascertained beforehand, the assailant, uncertain what counter manœuvres to employ, should augment the number of his skirmishers and place several sections on their flanks, which extend as the former penetrate the forest, and thus guarantee them from the risk of being out-flanked.

The only part taken by cavalry in such attacks, is, to cover in the first instance the flanks of the infantry, and to follow it at a certain, distance, so as to be ready to act as soon as any favorable ground is reached.

Artillery facilitates considerably attacks on forests, more especially when by driving the enemy from his abattis, and from the borders of the forest behind which he is placed, it opens the road for the assailants, but also when it succeeds in shaking him at the point where the real attack is made.

It is by traversing a forest in every direction, by examining attentively, and in the greatest detail, all the peculiarities of the ground as well as the local features, and by considering them all in a military point of view, that we can best arrange the plans and carry into execution the operations, which have for their object, the occupation, the defence, and attack of forests.

7. *Occupation, Defence, and Attack of Villages.*

The occupation of villages is generally determined on, because, with a similar number of troops, a more protracted defence can be made in them than in the field.

The means of defence increase in proportion as the means of attack are restricted by obstacles; such as ditches, hedges, palisades, and walls. These impediments which usually surround a village, arrest the assailants, favor the defenders, and paralyzing the forces of the former, give the latter marked advantages, even when inferior in numbers.

Villages situated at the foot of heights rarely admit of being occupied as posts; but the case is different when they are surrounded with woods, or stand on elevated ground, on rivers, or streams.

The nature of the country determines the position of its villages, both small and great. Their positions may, therefore, in mountainous countries, be in some degree foretold; but that is not so easy in countries consisting of plains and marshes.

Villages may be divided into two classes; regular and irregular. The first comprises those where the houses, built in a certain order, are connected with each other by hedges, and form between their rows what may be called streets.

The second class is composed of houses scattered here and there. They are met with mostly in hilly and marshy countries, their position being generally determined by the direction of the hollows, valleys, and gorges. Should a road or a rivulet cross these hollows, it generally passes through the middle of the village, the houses being on either side.

Villages built on rocky heights, are seldom compact; the houses are often scattered about, but the whole is considered as a village.

The plan of a village situated on the declivity of a mountain or a rocky slope can hardly be calculated on beforehand, the houses being sometimes adjacent, and sometimes scattered, according to the inclination of the ground.

Villages situated on even ground, or in a plain, have often as many streets as there are roads leading to, or branching from them ; from which circumstance, a general idea may be formed of their plan.

It is the same with those situated at the intersection of two roads.

By attending to these remarks the general outline of a village that has not been actually seen, may yet be sketched in a " descriptive note," and should it be afterwards reconnoitred, there will be little left to do, but to see whether its position and extent are correctly given.

It is not always necessary to know the number of houses which a village contains ; however, it does often occur in warfare, that officers are required to ascertain this point as well as the number of " fires ;" and as it would occupy too much time to count them all, they should obtain returns from every possible source, from the mayor, and any other persons in the public employ.

If this information be required with a view to the distribution of the cantonments, the farm houses should be carefully distinguished from the farm yards, because the latter will contain far fewer men than the former. It then becomes important to ascertain with accuracy the number of " fires" in a village, that the distribution of the troops may be arranged accordingly. From a general map of the country, the nature of the villages may be deduced ; it is sometimes shown whether such and such a village contains a church, a castle or chateau, a post office, farm yards, sheep folds, &c. From these indications alone, should nothing more be known of the country, it may be presumed that villages containing a church or a chateau, are more considerable than others ; a supposition which is often correct but may also occasion great mistakes.

Having reconnoitred the environs, the nature, situation, and extent of the adjacent ground, it must be ascertained whether the villages are surrounded with hedges and ditches, with walls of stone or of mud; if it is possible to retrench them, to make them points of "appui," for the army, or if they are calculated to contain a convoy in safety; whether there are any extensive granaries, stables, or cattle yards, suitable for the formation of magazines, or the accommodation of troops; and, lastly, what number of men and horses could be quartered there. It must next be taken into consideration, whether the houses are close together or scattered, constructed of stone or wood, covered with slates and tiles, or thatched, and easily set on fire.

Whether the inhabitants are in possession of any crops; what grain and forage they have; what horses, carriages, horned cattle, sheep, ovens, &c.

What number of mills there may be; whether moved by wind or water, and what quantity of grain they can grind in a given time; whether they are of wood or stone; whether they are capable of being retrenched, and of serving as posts; in short, to what uses they may be applied.

Mills often increase the facilities of fording rivers and streams from the head of water they require, it is consequently necessary to ascertain: 1st. The depth of the water in the upper reservoir when the sluices are closed; 2nd. That between the two reservoirs when the sluices are open; 3rd. The time requisite to allow the water to run down. These details may assist in planning the attack or defence of a mill converted into a post.

The quality of the water should be examined. It must be ascertained whether it is good for drinking, easily procured, abundant, and suited for horses.

The ditches, hedges, walls and the enclosures in the interior of the villages, and their nature, should be ascer tained. It should be observed whether the church is susceptible of defence; if it and the graveyard are enclosed by walls, ditches, banks of turf, hedges, or shrubs; whether they are raised, or on a level with the ground; lastly, if they can be retrenched and converted into good posts.

Villages should only be occupied when from their nature, they can be easily defended, and when such a defence is useful with reference to the general operations of the army.

Villages hardly admit of defence when the ground in their neighbourhood cannot be swept, or when their positions give the enemy any advantage, which is the case, for instance, when they are commanded, or when their approaches consist of hollow roads or of roads affording him good cover.

When on the other hand, the site is favorable, the villages to be defended, are: 1st. Those in the line of the position; 2nd. Those situated a little in front of this line; 3rd, Those forming the salient angles of a position; 4th. Any villages situated near the approaches by which the enemy is expected to advance; 5th. Those from which these approaches may be swept; 6th. Those placed in any defile which the enemy may be obliged to traverse; lastly, those in rear of the chain of advanced posts.

The villages and towns to be occupied when an army advances, or makes a retrograde movement are those which form a defile, or cover any that the columns may have to pass through; in this case, the troops of the advanced guard should occupy them, and in sufficient numbers to be able to stop the enemy until the arrival of the heads of the columns.

In case of a retreat, the villages should be occupied either by the heads of the columns, when the object is to receive these, and to secure their passage; or by the rear guard when it is wished merely to cover their march, and continue the retreat. These precautions should be observed in flank marches, with respect to every village from which the enemy might debouch, and fall on the flank of the column, in order to stop or retard its march.

It is scarcely possible to make an efficient defence of isolated villages, unless they are situated in defiles, on high mountains, or on the banks of rivers or lakes, when they cannot be attacked on all sides.

In all other situations, the successful defence of a village depends on the resistance opposed to the enemy by the troops posted in front, as well as on the occupation of a certain extent of ground, so as to guard against being attacked simultaneously in front and rear and on the flanks.

A village then should not be defended unless its flanks are protected by the fire directed from a position situated in rear of it, and occupied by troops placed there for that purpose; and again, the distance between the village and this position should be such, that the enemy cannot penetrate the latter without having first carried the former.

A village should not be occupied if the enemy may with safety neglect it, and leave it in his rear. It might, however, be advisable to hold a village, the occupation of which would be of advantage to the enemy; but it must be abandoned as soon as he endeavours to turn it, in order to advance towards the principal position, otherwise the troops left there would be exposed to being cut off.

For the same reason, villages, situated in an open plain, which the enemy can penetrate from all sides, and where he could overthrow by a charge of cavalry the troops in position, should either be left unoccupied, or have but a small force, and that only in the event of these villages happening to be in the line of position of the army.

The chain of out posts is too much exposed to the sudden attack of superior numbers, to allow of its defending those villages which may be on the prolongation of the line, unless their position in gorges or defiles should render them peculiarly capable of defence; and even then, the chain should be sufficiently close to enable it to receive assistance promptly; in this case, it is of the greatest importance that the supports should occupy those villages which from their situations might contribute to favour the retreat in case of need, and to stop the enemy as long as possible.

But, on the other hand, in broken countries where the accidents of ground render difficult the approaches to the villages, and are unfavourable for sharp attacks, they may be defended with advantage, and should consequently be disputed with obstinancy,

The Officer entrusted with the defence of a village of this description, should divide his force into three parts.

The first part should cover the village, and occupy that portion of the ground which the troops in the rear cannot ensure from being turned.

It is sufficient to line the hedges, palisades, and walls, with one rank of soldiers, who should be posted more thickly in those places where the fire of the enemy is most effective; whilst the streets and the other principal passes should be occupied by small compact bodies. The houses are held by detached men, those at least whence the fire may support the troops lining and defending the exterior " enceinte."

The second part, divided into small supports, should be placed behind the points most exposed to the attack, more particularly at those which are separated from each other by whole streets. These posts are intended to support and relieve the advanced parties.

Lastly, the third part should be concentrated in the centre of the village, and, if possible, in an open space equally distant from every point of the front line. This third post forms the principal reserve, its duty being to repulse the enemy on whatever side he may penetrate; to rally the advanced troops and cover the retreat, in case of being obliged to evacuate the village.

If there is time, all the avenues should first be closed by epaulments, barricades, and abattis; next, the walls should be loopholed and banquettes constructed behind the hedges; strong detachments should occupy the churchyard, the chateau, or any other position capable of defence, and from which the fire will most annoy the enemy; in short, all the means which are afforded by field fortification, should be employed to ensure the efficiency of the defence.

The Artillery should be placed in those positions whence it may produce the greatest effect, and on the points where it is probable that the attack on the village may be made; it is usually placed more particularly at the outlet of the principal street, or in other open spaces, so as to enable it to be easily moved; when practicable, it should be covered by an epaulment.

The cavalry is placed as a "*corps de reserve*," behind the wings, to ensure them from being turned.

To defend a village efficiently, the first attack should be received with a vigorous and well directed fire. Sorties should not be hazarded unless when the defenders are very superior in numbers, and when the assailants lay themselves open in a marked manner, as, for instance, if they expose a wing; or if the troops making the first attack are not supported; but these cases are rare. Still, when circumstances permit, sorties may be made; and the following are the principal rules which are then to be observed: 1st The sorties should be made rapidly, but must, notwithstanding, be conducted with the greatest precaution; 2nd That part of the village by which the party making the sortie will have to return, should be occupied in force; 3rd The village should be regained as soon as the enemy has been repulsed, and a rash pursuit should never be ventured on,

The resistance offered to the enemy in a village being useful, only in proportion to the injury he is made to suffer, and the time he loses, it should be prolonged with obstinacy, as long as possible. It is not enough to make a protracted and vigorous resistance outside a village, the ground in the interior should more especially be defended step by step, and the enemy must be made to pay dearly for what is per force abandoned to him.

Should the enemy penetrate at any point, and render the evacuation of a part of the village indispensable, by seriously menacing the flanks and rear, then the men driven from there should throw themselves on the line of houses, walls and hedges, and augment the difficulties of the attack, by presenting new impediments to the advance of the enemy. It is thus that the troops defending a village should fight to the last extremity.

Meanwhile, detachments from the reserve should attack the enemy on those points where he is weak; and should endeavour to turn and drive him back, in the hopes of gaining more easily one of the points on the new position to be taken up.

The officer defending a village ought not to rest satisfied with indicating beforehand to the officers of his detachments the point on which he intends to fall back and reform in case of a retreat; he should, moreover, take such precautions as will ensure his communications, and strengthen the new position on which he may consider it advisable to retire.

These precautions consist in forming openings by knocking down walls and palisades, by making banquettes, and throwing up epaulments, &c., &c.

If, after having defended the ground foot by foot, the enemy still advances, and penetrates to the further end of the streets and squares, or market places, the reserve should retire, and form in rear of the village, while those troops which remain to the last, use every possible means to prevent the enemy from passing right through it.

So much for the defence; now for the attack. The attack of a village being always a very difficult operation, where success is only to be obtained at the expense of men, it should never be undertaken unless there are no other means of obtaining the proposed object.

Supposing the attack of a village to be indespensible, whether as a measure of safety, to secure a point of " appui," or with reference to some other project, the assailants should be superior in numbers, for that alone, can counterbalance the advantages which the defenders derive from the position.

The local features most calculated to favor the attack of a village, are: 1st. A road by which he may be closely approached under cover; 2nd. A height from which a fire may be kept up with advantage ; 3rd. Salient angles which weaken the resistance : 4th. The absence or slight elevation of walls, palisades, and hedges. Those villages not protected by troops posted in their rear, may also be attacked with advantage.

The principal attack should not be directed solely on the point uniting all these advantages to the greatest degree, for the defenders might collect the larger part of their forces at that spot, and thus defeat the project; they should, in addition, be harrassed by false attacks, whenever the ground permits, and they are calculated to cause well founded apprehensions.

Before deciding on the attack of a village, it should be ascertained whether, from the nature of the ground and the localities, as well as from the dispositions of the troops defending them, any risk is incurred of being out-flanked.

The following proportions may be taken as an average in the distribution of the troops destined for the attack of a village: one-sixth for the attack, three for the supports and " posts of appui," and the remainder for the reserve.

Cavalry can only be employed in the attack of a village, to cover the flanks, and protect the reserves.

Whenever it is desired to force a village, artillery is of the greatest use, because it serves not only to dismount the enemy's guns, but also to annoy the garrison, by throwing shells on the troops defending the interior, destroying the enclosures of stone or earthwork, and levelling the surrounding hedges, &c.

The attack should be made by detachments of skirmishers advancing in open files, and without firing, on the points to be carried. They should rapidly clear any impediments they may meet with, and drive the enemy from house to house, and from street to street, without giving him time for consideration or permitting him to rally.

Should these detachments be repulsed, they must fall back and endeavour to find cover opposite the point they have attacked, and thence try to shake the enemy by keeping up a well sustained fire until the arrival of the supports, when they renew the attack.

The supports deploy and advance at a hundred or a hundred and fifty paces distance, according to the nature of the ground. They penetrate by the openings which should by this time have been made; attack and overturn the masses opposed to them; pressing them hard in the steets, open spaces, &c. and, in case of failure, the attack should be renewed with fresh troops drawn from the reserve which follows close on the supports.

Should the entry of the village contain streets or open spaces sufficiently large to admit of the defenders being drawn up in line, they must be attacked by the supports, which, followed by the reserve, advance in a compact body, the skirmishers still retaining their open formation.

As soon as the enceinte of a village has been penetrated, the sappers, who in this case should always march with the reserves, open the communications, levelling and overturning all impediments.

When the points of attack are near each other, one reserve placed on the most important points is sufficient, but when they are too far apart, each column should have its own; the object of these reserves being to rally the troops and cover the retreat in case of failure.

But, on the other hand, should the village be penetrated, and the troops be enabled to advance, the reserves will rapidly gain a central position by the principal entrances, as well to assist in routing the adversary's reserves as to seize on those points which ensure the safe occupation of the interior of the village, whilst the skirmishers and their supports pass through and proceed to occupy the exterior line of defence.

8. *On Mountain Warfare.*

Those who make war only in their studies and on maps, imagine, that to keep possession of a mountainous country, every approach to it, and every position must be defended, and that the armies so engaged must occupy all the summits.

To hold and defend all the approaches, valleys, heights, passes, and positions, would be to take precautions unnecessarily detailed, and would be a generally defective disposition. To place an army on the highest points of the mountains, is to forget the difficulties of transport by impracticable paths, and the impossibility of provisioning for any length of time any considerable body of troops so posted.

The true principles to be followed when it is desired to defend a mountainous country consist:—1st. In never losing sight of the essential points; 2nd. In concentrating all the means of defence at those positions which command the keys of the mountains: and 3rd. In not detaching secondary posts unless they have an immediate relation with the principal object. Nothing is gained by disseminating the troops on all the different points, thus sacrificing them in partial, and often useless combats.

Before laying down the principles which it is proposed to establish on the subject of Mountain Warfare, principles more misunderstood than novel, it is indispensably necessary: 1st. To offer some considerations on the nature and general conformation of the ground in mountainous countries, which may serve as a guide in judging of the most advantageous direction which can be given to the general operations; and 2nd. To indicate the method of proceeding to make a detailed examination of the different portions of the ground, and the local features in order to plan the minor operations.

General Considerations on the Nature of the Ground in Mountainous Countries, and on their Examination as a whole.

Extensive mountain chains form the best barriers of a state. It is generally on the declivities of the mountains that the rivers and streams take their rise; and it is along the banks of the latter that the most practicable roads are almost always found; sometimes also the waters open for themselves, through the mountains, passages of which the sides are so perpendicular as to be impassable. Mountainous countries present almost everywhere good positions, but they are for the most part liable to be turned.

The reconnoissance of a country of this nature should be commenced at the most elevated part, whence the waters and ravines fall to the right and left, and their origin should be noted. The rivers, streams, and principal ravines should then be followed as far as possible, specifying their numbers and extent; the nature and direction of the different chains of heights which traverse, encircle, and cover the country must be observed; their relative elevation, and the different branches which defend the outlets from them; their communications, and the courses of the rivers and torrents.

With respect to the mountains, their chains must be traversed to ascertain their development and points of connection, as well as the facilities or difficulties which troops would meet with on their slopes and declivities; and lastly, some positive data should be obtained on the points to be occupied, the communications to be opened, destroyed, or closed, by traverses, redoubts, or abattis, either with a view to operating on a projected plan, or simply to secure the front flanks and rear of the positions to be occupied.

In the descriptive notes to be annexed to the sketch of country, the nature of the roads should be specified, and exact details given of those which are fit for carriages, artillery, horses, and mules; and of those only suited for foot soldiers, as well as of the period of the year when they are most practicable. In these notes the most cramped and difficult parts of the defiles and and encampments should be described; and observations added on the rivers, streams, torrents, and ravines to be passed, and which become swollen at every fall of rain or on any considerable melting of the snows; indicating the best means of overcoming the impediments which may have to be encountered.

In high mountains, such as the Alps and the Pyrenees, roads are rare, because the valleys alone are inhabited. If the valleys, as well as their approaches and outlets, and the passes that have been opened are well studied, the examination of the mountains may be dispensed with, excepting their roads and beaten paths.

Detailed Examination of the different parts of the ground in a Mountainous country and of the Local Features to be met with there.

In the detailed examination of a country abounding in mountains, those which command the others should be considered first; their positions separately, as well as relatively, to the others; the means of reaching their summits, and the most important parts to be occupied in a general point of view, as well as with reference to any particular object. It must be noted whether their summits consist of bare rocks or are covered with woods, wholly or partially, or whether they are clear: whether they form posts which it would be advantageous to occupy; and if so, with what object.

The crests, necks, passes or passages, must be next examined; the roads and paths which traverse the summits and sides of these and the valleys. It must be ascertained whether or not the valleys are practicable, or if they merely present difficulties; whether artillery and cavalry can traverse them, or only infantry. The outlets and defiles leading to them should also be carefully examined, and it should be remarked whether they may become favorable or the reverse.

The nature of the declivities and slopes of the mountains must be noted, also that of the woods should there be any; and of the streams, pasturages, towns, villages, hamlets, castles, farms, mills, and detached houses. Are they capable of being converted into advantageous posts in a military point of view, and what position would be most suitable for encampment? It must be observed, whether there is any table land or plateau beyond which the enemy might advance and by occupying it thereby command a considerable extent of ground. There may also be other table lands which might assist the enemy in his enterprises, were he to seize them; those points must be taken into account by which the enemy might turn the posts or positions which it is proposed to occupy, and by which he himself might be turned; and search should be made for some unfrequented paths or passes which would facilitate the accomplishment of this object.

It should be ascertained whether the heights of medium elevation are practicable, and if they may be occupied with advantage; whether posts of observation and batteries could be established there. The nature of the communications with the ground in rear must be looked to; it must be noted whether they are short and easy; whether they are liable to be intercepted by the enemy after the mountain range has been penetrated; what are the best means of ensuring their safety; and accurate information must be obtained as to the different periods at which the mountain passes are open, or are closed by the snow.

The local objects which may be met with in mountainous countries, and which should be examined in the most minute detail, are the following;

Roads, Defiles, Rivers, Ravines, Vales, Valleys, Towns, and Villages, Hamlets, Isolated Houses, Forts.

ROADS.—There are few mountain-ranges where roads may not be found extending along their whole length; and these, though little frequented, may often be useful. On the plateaux also, may be found roads little used, but, nevertheless good, even till late in the season. In mountainous countries the roads are generally steep and narrow, and, consequently, but ill adapted for the transport of artillery. They may be divided into three classes, namely,—roads practicable for carriages; those which are fit for beasts of burden; and those suitable for foot soldiers only.

These roads are often obstructed by snow. It is important to know, as has been already remarked, the periods or seasons at which they are open or closed. Roads are more or less open in certain places, and sometimes so steep as to render it difficult to traverse them; some are straight, others crooked or winding.

In countries covered with hilly plains, the roads are generally hollow when they approach the towns and villages; and when two rivers or two valleys some leagues apart, run parallel to each other, the intervening space generally consists of a mountain whose slopes are furrowed with hollows and hollow roads, but on whose crest, practicable throughout its whole extent, may often be found a better road than those on its sides.

The high roads flanked by rocks are often barred across by works in masonry, but such barriers are, in reality, only calculated to impede for a time the march of the enemy's columns, and that of his carriages; they seldom extend beyond the narrow limits of the passes they close, and do not protect their defenders either from being turned, or from the plunging fire directed from the neighbouring heights.

To enable such works to offer a long resistance, they should be casemated and closed in rear as well as in front; they are then sheltered from fire, and from stones rolled down from the heights commanding them, and their defenders are no longer in danger of being turned, but when well supplied with provisions and ammunition, will disconcert the enemy's operations, either by stopping the advance of his columns, or by interrupting his communications.

Common paths may sometimes, by a little labour, be converted into excellent roads: the people of the country often look upon them as impracticable for troops when they are narrowed by ditches or other inpediments.

Hollow roads, which cannot be filled in, should be used as seldom as possible for artillery or baggage waggons, if one carriage were to break down or get fast in the mud, the remainder of the column would be stopped at once.

Defiles.—Defiles are of frequent occurence in mountainous countries; they may be more or less cramped, more or less practicable, and frequented. An accurate knowledge of their breadth and length is necessary, in order to estimate the numbers of infantry and cavalry which can enter them abreast, and the time that will be occupied in passing them.

It must be ascertained whether their direction is straight or winding: whether at their entry or exit there is any advantageous spot where a given number of men might be drawn up in order of battle: whether batteries or posts could be established there, capable of covering and protecting a retreat, and if there are any neighbouring positions which should be occupied: if there are any passes which ought to be seized, either with a view of debouching on the enemy or of stopping him; which of them, if any, should be fortified; and which are suited for artillery, waggons, and other equipages; which for cavalry or infantry: whether their communications are direct or the reverse, by the flanks or the rear. It should be known how long it will take to reach the highest part of the crest or summit: and, lastly, whether any new passes can be opened.

RIVERS.—Rivers proceeding from mountains are rapid and shallow near their sources: their banks are almost always bordered with heights, the prolongation of those whence they take their rise.

These rivers become swollen with extreme rapidity, either from heavy rains, or from periodical floods, of which there are generally two every year; the first in March or April, when the snows begin to melt, and the second about the month of July, when the summer heats complete the conversion of the snow into water. It is important to have accurate information on the subject of these floods, so that the movements of the troops may be eegulated accordingly. The bottom of rivers proceeding from mountains is generally good; they are fordable in many places, but the fords are generally obstructed by large stones, rendering them very inconvenient for horses, and impracticable for artillery and carriages.

RAVINES.—In mountainous countries ravines are often and suddenly converted into torrents, which vary with every storm of rain; it should be ascertained in what weather these storms occur, and if the waters run down quickly. When the torrents cannot be sounded, information should be obtained from the country people as to the breadth and depth of the water; if the bottom will permit of cavalry passing without risk; if there is any danger of the banks falling in; and whether, from the melting of the snows, or other sudden rise of water, the ravines become converted into torrents.

Ravines, inconsiderable at their commencement, often become precipices. Those whose sides are level with the ground are generally the most dangerous, unless their position is known, but they form excellent points of "appui." Ravines are occasionally met with of which the outlets are quite practicable, and their bottoms fall in a gentle slope, and are dry, at least in summer.

A ravine of this description may serve as a road for a column, so that it is important to know their direction, that is, on what road they terminate, and the amount of labour that might be necessary to render them partly or entirely practicable for the passage of cavalry, or of infantry only; their breadth throughout should always be well known, especially when they lead to the banks of a river or stream. Prudence requires that the outlets from such ravines be guarded by detachments,

It is generally essential to examine attentively the nature of the ground forming the sides and bottom of a ravine; they may be of rocks, of earth, mud, rolling stones, gravel, or sand; it should be observed whether the ravines are wide and deep, sloping gently or scarped, whether a ramp may be made in the steep banks to facilitate the passage of the troops.

VALES.—Vales deserve great attention. It should be ascertained whether they, as well as the valleys surrounding the heights, are extensive, inhabited, wooded, cultivated, intersected by rivers, streams, and ravines; whether they produce grain and forage; if they can be traversed by troops conveniently, and in safety; whether the mountains and heights which form the vales, are at such a distance that the columns passing through the latter would not be annoyed by the fire of the enemy posted on the crests; and above all, whether it would be in his power to shut them in.

Those valleys which are intersected, either longitudinally or transversely, by a great number of obstacles, streams, and winding ravines, are often impracticable for troops, on account of the multiplicity of bridges to be constructed and of passages to be opened.

Towns and Villages.—The towns, villages, hamlets, and detached houses, situated at the foot of heights, or in hollows, are rarely susceptible of being converted into posts, but, when circumstances require their occupation, their defects should be obviated, or at least, remedied by entrenchments.

Entrenchments have the advantage of producing an effect at once moral and physical: they arrest the impetuosity of the adversary, while they cover the troops defending them; they direct the attention of inexperienced officers to the important points, the employment of the troops and artillery being determined by their situation. But, on the other hand, entrenchments lose their value, unless made use of with judgment, as, for instance, when they are badly placed, when their construction is defective, or again, when they are badly defended,

A feeble defence is but too common, and arises from the infantry being taught to use their arms only when at a distance; in their not being inspired with equal confidence in the bayonet, as in the fire of musquetry; and lastly, in their not being sufficiently practised in fighting hand to hand.

The result of this neglect is, that, should the attacking party not be disconcerted by the first fire, the defenders become panic-struck, and seeing the only mode of defence they are acquainted with, attended with no result, they allow the work to be carried at the very moment when the assailant occupied in passing the ditch and scaling the parapet is in disorder, and cannot make use of his arms, whilst every advantage is in reality combined on the side of the defenders. An intrepid leader, making his men mount the parapet, when the enemy throws himself into the ditch, receives him with the bayonet, and does not fear the escalade of a well constructed work.

Forts.—Forts built on mountains and rocks are sometimes so elevated as to facilitate the approaches of the assailant, the guns being able to deliver only a plunging fire; the greater number of these posts are often without water especially when they depend on springs or wells, which dry up in summer, and then the garrison reduced to the rain water, which soon stagnates in the cisterns, is obliged to capitulate.

Having explained the method of examining the different descriptions of ground, and the local features of mountainous countries, and having shown the military point of view under which they should be considered, it remains to lay down the principles by which all officers should be guided in mountain warfare.

In this description of warfare, the selection of officers entrusted with the command of separate corps is of the utmost importance, for on them depends often the success of the greatest enterprises; and the more so, as the natural obstacles of the country prevent the Commander-in-Chief from perceiving and remedying any errors that may be committed. It is principally in mountainous countries that the talents of individual officers shine forth, and that they find many occasions of distinguishing themselves, as much by giving proofs of their intrepedity, as by their unshaken bearing in critical situations.

In mountain Warfare, the only merit that the generals have, or can have, is that of planning the general dispositions and combinations; nevertheless, their task is great, for they are responsible for all miscalculations, and for errors or tardy measures which might interfere with the promised result of the best calculated combinations, and with the proposed plan of operations.

The month of March is the most favorable period for commencing military operations in mountainous countries, because the cold is no longer sufficiently severe to stop the movements of the aggressor, whilst it is insupportable for him, who, acting strictly on the defensive, is obliged to keep the heights, and who finds himself confined to his post, without shelter, without wood, fire, or any thing to alleviate his hardships.

In the month of March, the snow is still hard enough to render level the approaches to the heights, covering the fields and filling the ravines, in such a way as to allow of sections marching over places which it would be difficult in summer to pass in single file.

The rules of mountain warfare prohibit the entry of the valleys until the heights are mastered. This principle is good, but is based on the supposition, that the enemy would occupy the heights, and that these command the valleys to be traversed.

In a tactical point of view, and when a manœuvre is to be executed on a field of battle, the advantage of commanding ground is too great to admit of the preference being accorded to an attack directed from lower ground against that which is higher: but the principle should not be here too rigorously applied, nor should it be supposed that the command of the watershed necessarily gives that of all the communications; indeed, it is quite otherwise, when, in conducting operations in a mountainous country, possession of an entire valley is obtained with the view of gaining ground in the mountains, and of pushing the operations beyond them.

In this case the attack should be directed from the plain, because measures on a larger scale can be taken there, whilst those of the adversary, who is on the defensive, diminish, and his facilities of acting are lessened, as he is driven back.

The following may in this case be considered as principles: 1st. Both systems should be employed simultaneously; that is to say, the troops which are in the plain should be directed up the valleys, whilst the heights surrounding them should be secured; 2nd. The selection of positions to be occupied, and the direction of the movements should not finally be decided on, until an exact knowledge of the contour of the mountains is obtained, as well as of the nature and situation of the principal valleys it may be wished to penetrate.

Among high mountains, where it is only by following the direction of the valleys that any progress can be made, and when the difficulty of procuring supplies prevents any rapid movements, the effect of any manœuvre is not felt at so great a distance as in open countries. This circumstance alone, which is owing to the nature of the ground, is an undeniable proof of the truth of the principle, that in a strategetical point of view, the possession of the plain leads to that of the mountains, where each step in advance is made only at the expense of a fresh enterprise, and where the numerous variations in the configuration of the ground require different dispositions, adapted to the various local peculiarities.

It is the genius of the officer entrusted with the direction of the operations that enables him to conform to these natural peculiarities of the ground, and above all, to avoid the dangers of a critical position, or a false movement, which are the more to be dreaded in countries abounding in obstacles, because any rapid manœuvre, which might otherwise obviate the disadvantage of a defective disposition, would be impeded by the nature of the ground.

In an open country, the dispositions of the enemy may be discovered from a distance, and his intentions may be foretold; and should his movements be such as to give no indication of their object, there is at least both time and means to prepare for evey contingency; should he make any rash attempt, he may be punished for his temerity, advantage being taken of the opening he may give.

This consideration shows the great advantage of the attack over the defence in mountainous countries, and inculcates the necessity of going back to principles, whether in the study or practice of the science of war, in order to be able the better to seize the true spirit of the rules, and thus avoid fatal mistakes when the necessity of applying them occurs;

then it will be seen that a movement which would in a plain be imprudent and dangerous, ceases to be so among mountains.

Acting on the offensive produces, moreover, a moral effect on the mind of the soldier, advantageous to the aggressor who has the resources of art in his favour: in short, he who attacks, forms his plan, decides on his movements, unites his forces on a given point, and gains a superiority, which he who is attacked, can only hope to counterbalance by paralyzing the means of his adversary, and preventing the deployment of his forces. But to succeed in this object, he who acts on the defensive should avoid every useless combat, and only offer resistance in advantageous positions, employing troops of different descriptions according to the nature of the ground, and seizing without hesitation, the favorable moment for assuming the offensive.

Nowhere will audacity perform more prodigies than in intersected countries, and more especially among high mountains, where the only affairs are those which are undertaken and decided without warning, and where surprise, the general result of boldness, paralyzes the forces of the adversary at the most critical moment.

Generally speaking, the only positions which can be defended boldly, and with some hopes of success, are those which afford their defenders the means of defeating all the projects of the assailants; that is to say, the former should be safe from a surprise, a masked attack, or any sudden manœuvre, &c.; but these qualities are seldom found united in a position among mountains. However, as the general operations sometimes require the occupation of a subordinate line, or the defence of the entry or outlet of some lateral valley, to impede for a time the movements of the enemy, by occupying posts, which must yield at last to his combined efforts, positions taken up with this intention, should be at least protected from being enveloped by the superior forces of the enemy or from being attacked by a cross fire, which would oblige the defenders to evacuate them; and the ground should be such as will not admit of an attack disproportioned to the means of defence; moreover, the advanced posts should be placed at such distances as to prevent all surprises, and to stop the enemy, long enough to enable the officer commanding the main body to be informed of his projects, and to take measures to frustrate them.

The avenues leading to a position, and indeed, every mode of approach, should be visible to the troops charged with its defence; they should be open to the fire of the artillery, and commanded, if possible, from points selected with reference to the local peculiarities. The reserves should be sufficiently near the points of attack, to allow of their being brought up to support them at the decisive moment, yet they should be kept at such a distance as will guarantee them from the effect of the first fire, or from sharing in the first reverses. Lastly, a safe retreat should be insured; and if this must inevitably lead through a defile, it ought to be occupied beforehand, otherwise the loss of the position might lead to a total defeat of the troops defending it.

There is no lack of principles to serve as guides in mountain warfare, but their application varies with the different cases that present themselves; from this it results, that faults are repeatedly committed against the true principles, not so much from their being unknown, as from their being erroneously applied; and as men are generally more apt to exercise their memory than their judgment, they are content with remembering the rules which have been handed down to them traditionally, without investigating their meaning, and then, when in complicated circumstances things are presented under different aspects, they are unable to decide on the rule which applies to the case in point.

The astonishing campaign of 1799, during which the belligerent armies disputed the possession of the most elevated parts of Europe, is peculiarly interesting, and the more remarkable, in that it presents the means of victoriously combating the misconceptions which are common with respect to mountain warfare, and which it is important to demolish, because men, otherwise well informed, regard them to this day, in the light of incontestable truths.

In order the better to appreciate the system which ought to prevail, not only with reference to the defensive positions to be taken up in mountainous countries, but also to the modes which should be employed in order to gain these positions, it is necessary to explain and analyze the systems which have been followed up to the present time; these may be reduced to the following: 1st. Occupying all the valleys; 2nd. Taking up a position which bars the principal valleys right across; 3rd. Taking up a position lengthways, along the principal valley; 4th. Occupying simultaneously the valleys and the mountains; 5th. Occupying the mountains, and observing the valleys; 6th. Taking up a central position at the point where the different lines unite, and keeping simple posts of observation in the valleys, on the passes and paths in front, flanks, and rear of the position.

OCCUPATION OF THE VALLEYS.

Inconveniences of the system.

High mountains, as has been already observed, are traversed by valleys, having their origin in the principal crest, and which, from their first branching off, have seldom any other communications, than the paths across the steep sides which enclose them. The lines of operation and communication follow these valleys, and unite as they do in the same direction: from this it follows, that several roads lead to the same point, and that he who wishes to advance on the offensive, from the plain to the mountains, may choose his line of attack, and throw the principal part of his forces on that outlet which he may think most favorable for his designs; whilst his adversary, who is awaiting him in the several valleys, among which his forces are divided, can only gain the valley towards which the assailant is advancing, by re-ascending to their common source, or at least by making a considerable circuit; otherwise, a military occupation of all the valleys would require that the troops destined for the particular defence of each, should be sufficiently numerous to repulse every attack without any assistance, for that which might be furnished from the neighboring valleys, would never arrive in time.

But what a prodigious quantity of troops would be necessary to carry out this system to the full extent in a mountainous country! And how are these troops to be subsisted? For in sterile countries it is not sufficient to proportion the quantity of provisions to the number of fighting men; the subsistence of the men and horses employed in the transports of stores &c., must also be taken into account, and they often consume the greater part of their charge before reaching their destination: and even supposing the magazines to be capable of supplying the want of resources in these inhospitable regions, thus obviating these objections, the impossibility of finding in the mountains positions calculated to stop the enemy, would still remain. There is no one position which he is obliged to attack more than any other, for the several different roads lead to the same point, no position can be strong enough from its situation to be independent, nor can the flanks of any be guaranteed as perfectly safe; insolated, from the nature of the ground, they are all exposed to be turned, and an enemy by leaving them, will seldom endanger his communications, the ground being unfavorable for any prompt or vigorous enterprises.

POSITION TAKEN UP ACROSS A VALLEY.

Defects of this Position.

Every position which bars a valley has the following defects: 1st. That of having its wings resting on heights which command them; 2nd. That of having the line divided by the waters that run in the bottom of the valley, when an attack made with superior forces, either from the mountains upon the wings, or on one portion of the centre which is divided by the waters, would be decided in favor of the attacking party, and the more completely, inasmuch as the remaining troops of the corps on the defensive are generally taken in flank or rear, or else neutralized.

POSITION TAKEN UP ALONG A-VALLEY.

Advantages and disadvantages which this Position presents.

A position taken up along a valley has the following advantages; 1st. Its front is covered by the streams running before it; 2nd. Its wings rest on one side, on the gradual elevation of the ground, and on the other, on well guarded defiles in the bottom, or on torrents, or the lakes which receive the waters of the lateral valleys.

Such positions are difficult of approach, because the points by which the enemy might debouch from the opposite mountains, and crossing the water, attack the defenders, are marked by the nature of the gronnd itself, and admit of no alteration; whilst defence is easy for him who occupies the valley, his movements being more free; and should the assailant even attempt an attack by a lateral valley, this would not ensure him the conquest of the principal one; for he who occupies it being able to unite and deploy his troops at will, enjoys a decided advantage over an adversary, who debouches by a narrow gorge from which he dares not venture far, fearing to find himself cut off in case of a reverse.

We may here observe, that one of the errors in military matters, which arose with the cordon system is, that the defenders of every post, strong or weak, forming part of a line of any extent, and whether in a secure or dangerous position, consider themselves turned, out flanked, and obliged to retire, as soon as the enemy has penetrated at one point, and have no hopes of safety, until they find themselves posted on a new line parallel to the first.

It is especially in mountainous countries that the soldier fears being turned; not being able to embrace at one view the variety of movements on both sides, his judgment becomes as limited as his sight, and he experiences uneasy feelings because he is unacquainted with the nature of the ground: whilst it is precisely among mountains that there is less danger to be apprehended from being turned, than elsewhere, because that manœuvre can only be executed by small columns or isolated detachments, which, being confined to difficult mountain paths, may be stopped by a small number of men.

Whilst decisive blows are being struck elsewhere with superior forces, the surest way to carry positions taken up along a valley is, to turn them; should circumstances permit, the valley itself may be attempted, by an attack directed against its outlet, which should be penetrated with superior forces.

To facilitate this operation, the means of resistance of the enemy should be paralyzed, by attacking his flanks and rear simultaneously, with small columns, directed for this purpose by the lateral valleys; and to avoid all risk, the advance of these small columns should be regulated by that of the main body, they should be within reach of it, and follow in echellon. Should any obstacles frustrate this attempt, the crest where the valley takes its rise may be ascended with almost the certainty of encountering but feeble detachmnts there, since it is impossible, as has been before said, to provide any considerable body of men on these insolated posts with stores and provisions for any length of time, when, moreover, the difficulties of the ground would not admit of the defenders taking efficient measures to protect themselves from any concealed movements. Thus, the assailant climbing with superior forces the mountain barrier, gains the commanding points, whence he overwhelms his enemy posted in the low grounds; or, again, as all the valleys take their rise from the same crest, and are there close to each other, the assailant having reached the summit, finds himself in a position which allows of his passing from one valley to another much more rapidly than his adversary, who is shut up in that which he occupies; and the slightest success will lead to the possession not only of the principal valley, but also to that of several of those adjacent.

From what has been just shown, it is evident that a valley occupied lengthways may be easily gained, either by directing the attack against its outlets, and penetrating with superior forces, or by obtaining possession of the mountains surrounding it.

It may be remarked amongst the inherent defects of a position taken up along a valley, that its occupation must be precarious, because a road which serves as a field of battle, is a bad point to occupy, and the probability of success can never be in favor of him, who, placed on a cramped and perpendicular line, is obliged to fight at once on its two extremities as well as to its front and rear.

When from the nature of circumstances it is necessary to occupy such a position, the only hopes of being able to do so with advantage, depend on taking the initiative; and nowhere may this means be employed to more advantage that in a mountainous country; for, in consequence of the numerous obstacles, it is very difficult to execute any counter manœuvre, the paucity of communications, and the difficulty of conveying intelligence, occasioning an incalculable loss of time; and, as it often happens, that circumstances change before the execution of any settled plan, the assailant, by pushing on vigorously, may succeed in obtaining a series of advantages, of which it would be very difficult to deprive him afterwards.

POSITIONS TAKEN UP SIMULTANEOUSLY IN THE VALLEYS AND ON THE MOUNTAINS.

Inconveniences with which they would be attended.

The mountain ranges descend, by stages, in such a manner, that those adjoining the valleys are always commanded by more elevated summits. If, to obviate this inconvenience, which arises from the nature of the ground, the valleys are occupied, and the surrounding heights guarded at the same time, an immense extent of ground must be embraced; for each range being commanded by that beyond it, the troops will be all dispersed by the time the highest is occupied; from this results a multiplicity of detachments and posts, the greater part of which, isolated from the broken nature of the ground, without intermediate communications, and too far apart to afford each other mutual support, give every advantage to the assailant, who, pursuing some one direction, masked by the ground, advances with the mass of his forces, against one point, carries it inevitably, and takes in rear all the scattered troops confined to their respective posts, and guarding those approaches alone which lead directly to them.

If the attack made in the mountains should succeed, the assailant gains the heights which command and adjoin the valleys, as well as the roads and paths which turn them; thence he may make a descent on the communications of his adversary, or else establish himself on the neighbouring mountains, in short, he obliges him to evacuate the valley, either by turning him, or by main force; and in either case, the results are generally attended with circumstances which are very disastrous to the party attacked.

POSITIONS TAKEN UP IN THE MOUNTAINS, THE VALLEYS BEING MERELY OBSERVED.

By merely observing the valleys, while the mountains are occupied by the main body, the danger is incurred of the enemy making a false attack, with small detachments, on the troops holding the mountains, whilst he overwhelms, with his principal force, the posts of observation in the valleys; intercepts the roads and paths leading to the mountains; stops the reinforcements and supplies of all sorts on their way; menaces the line of retreat of the troops stationed there; and, in short, forces them to abandon their positions.

But what system, then, is to be followed, when a corps is obliged, by circumstances, to remain on the defensive?

That in which the valleys are occupied with the main body, in order to command the mountains, and in which these are merely observed with small detachments, for the mountains command the valleys; and these alone contain the roads suitable for the movements of troops, and practicable for the transport of provisions and stores.

Such is the outline of the system which we will now proceed to develop.

A CENTRAL POSITION TAKEN UP AT THE POINT OF JUNCTION OF THE DIFFERENT LINES, WHILST SIMPLE POSTS OF OBSERVATION ARE KEPT IN THE VALLEYS, ON THE PASSES AND PATHS IN THE FRONT, FLANKS, AND REAR OF THE POSITION.

Amongst other peculiarities, which, in mountainous countries, depend on the nature of the ground, is this, that an operation may be directed against any point by several different lines. The main object, then, is to find a central position, from which these different lines may be most easily reached; and this can only be found at their point of junction. As it is, however, indispensable to be in possession of good information with regard to the projects of the enemy, in order to avoid making false dispositions, it becomes advisable to place posts of observation in all the valleys, and all the passes and paths in the front, flanks, and rear of the position.

Then, the intention of the enemy being ascertained, and it being known that he is sufficiently advanced in one direction to prevent his changing to any other, he may be attacked without danger, either on the line of operation which he is following, or any other which may promise advantageous results.

By defending a mountainous country on this system, a superiority over the adversary is obtained; having a knowledge of the country, and time to take all necessary steps to establish magazines and to organize the transport service, there is no excuse for not acting with celerity and vigour, whilst the enemy can, with difficulty, collect his subsistence, and everything must follow him on that line alone by which he advances.

In the defence of one's own country the attachment of the inhabitants will offer valuable resources, and of more importance in a mountainous country than in the plains.

By pursuing the above system, forces may be opposed which are more numerous than those of the defenders, and far superior to them; for a difficult country can be penetrated by isolated columns only, incapable of affording each other mutual support, and constantly exposed to unfortunate accidents, more particularly if a vigorous attack is directed against that column whose defeat will alone suffice to oblige the others to retreat.

But to obtain such a result, the resolution must be prompt and the execution rapid, so as to prevent the other columns from joining before the complete defeat of the one attacked.

A central position is, moreover, preferable to any other line of defence on the score of provisions. The requisite means of transport are not so great, because, as the attack will only be directed against the divided forces of the adversary, the position will only contain a number of troops proportioned to that intention; and magazines will be more easily formed, because, by occupying the points of junction of the different communications, the convoys may be brought in by different roads, without the necessity of distributing the supplies over unconnected lines.

It is, then, only by acting offensively from a central point, that the mountains can be held; and this maxim is too well founded to be neglected. The words "acting offensively," are used designedly, because it might be thought from the explanation given of the advantages of a central position, that the enemy should there be waited for: far from that, we repeat, that all positions among mountains, not excepting those on the very crests, are exposed to the same inconveniences, they are too extensive, and possess too few resources; the detached posts, not being independent, are obliged to preserve a passive attitude, without being able to manœuvre; the modes of retreat are difficult, and by paths often impracticable; such are in part the defects which characterize those positions.

It would be highly inconsistent, and, indeed, totally against all principle, to remain fixed in a position when the enemy might unite his forces in front of it and assail it from all sides; for when it is advanced, as a principle, that a position should be taken up, or reserves established at the point where several roads branch off, it is not with the view of awaiting the enemy, nor of making a stand there, but in order to secure the choice of the different directions leading to him, so as to be able to overwhelm him by making a descent at the most favorable and decisive moment.

As soon as the adversary is repulsed, those detachments that were guarding the approaches of the position regain their posts, and the main body re-establishes itself at the point whence it started; these offensive attacks should be repeated as long as it is necessary to act on the defensive.

These considerations prove the immense advantage of the attack over the defence in mountain warfare, with reference both to strategy and tactics. He who takes the initiative, by acting decidedly on the offensive, will always remain master of the field of battle, and, finally, of the theatre of war. The officers who have to operate in mountainous countries should be thoroughly convinced of this truth.

In support of these principles, we may cite the opinions of the Duc de Rohan, of Lieut.-General Le Courbe, and that of the Archduke Charles, on mountain warfare. The Duc de Rohan, who commanded the French army in the Valteline, in explaining the dispositions made with a view to prevent the junction of the Spanish and Imperial armies, says: " This obliged me to send out persons experienced in " those matters to reconnoitre the passes, which were found " to be innumerable; and then, indeed, it was ascertained " that mountains are like an open country, having not only " the customary roads, but many others, which, although " not known to strangers, are familiar to the inhabitants of " the country, and by which one may always gain any desired " point, in spite of those who would oppose such a design; " so that a wise commander will never be anxious to guard " the passes, but will rather resolve on waiting for the enemy " and giving him battle in the field, which method may " appear strange to those who have not had experience of " its success. Thus, on the present occasion, where the " mountains were considered as safe as so many fortresses, it " was found that they were open on all sides, and that ten " new passes were discovered for every one that was blocked " up, so that not one good army, but several, would have " been necessary to guard such a country."—*Campaign of the Duc de Rohan in the Valteline*, 1674.

Extract of Notes on Switzerland, addressed to General Berthier, by Lieut.-General Le Courbe, 22nd April, 1800.

" Taking into consideration the topographical situation of " Switzerland, the defiles by which the enemy must pass to " reach it, the difficulties he would encounter with regard to " subsistence, and the stratagems by which, in certain positions, small bodies of troops might stop a considerable " number, &c., I estimate, that with seven or eight thousand " men, the outlets of the southern Alps and of that part of " the Rheinthal next the Grisons, may be held until the

" army of the Rhine shall have passed the Lake of Constance, " without including what should be left in Camp at Bâle and " in the Friekthal, in order to escort convoys.

" The Canton of the Valais could with difficulty be held; " the different approaches from the Milanaise and Piedmont " show at a glance, that many men would be necessary to " keep such a country.

" Five or six battalions will suffice for the defence of the " valley of the Rhone, but they must not be scattered; " they must be kept in the valley; nothing more than simple " posts being on the crests of the mountains where the " passes are.

" In an invasion of the Vallais, or even of the valley of " the Reuss, the chances are against the enemy; for, should " he have a considerable body of troops, they would starve.

" The country offering no resources, he would be obliged " to pass his convoys over the mountains on beasts of burden, " or to have them carried by men, the inconvenience of which " is evident.

" If, on the other hand, the enemy has but few troops in " the places above mentioned, a small reinforcement would " enable us soon to retake all the posts we might have lost; " for these mountains, the St. Bernard, St. Gothard, &c., " present no really good plans of defence; he who attacks, " is almost always sure of success.

" It is in the valleys that the mountains must be defended.

" This reflection will perhaps appear surprising to those " who have not made war in the mountains; but should you " have strong reserves at the outlets of a mountain, throw " them on the enemy at the moment when, having just had " seven or eight leagues of ascending and descending, he is " overcome with fatigue, and in such a case, it is pretty cer- " tain that he will not reascend, but will be taken prisoner. " I could cite many examples of this."—*Précis des Evénements Militaires, M. D.*

In a military work entitled "*Campagne de* 1799 *en Allemagne et en Suisse*," attributed generally to the Archduke Charles, the author thus expresses himself: "The theory of "mountain warfare has, perhaps, never been presented to "observers in so clear and striking a manner as during the "Campaign of 1799, when the belligerent armies disputed "the possession of the most elevated countries of Europe. "This period, particularly distinguished by the rapid pro-"gress of the operations, gives to the campaign a new "character.

"Instead of traversing the crests on lines parallel with "the original position, as generally happens in countries "of this description, where it is only necessary to clear one "chain to find another parallel to it, or to descend into the "plain beyond, the positions taken as starting points, were "perpendicular to the run of the mountains, and it was "endeavoured to master them by traversing the chain length-"ways, and by following the direction of its branches.

"The result of these dispositions lead to the following "observations: 1st. The possession of the flat country pre-"pares and assures, on strategical principles, the occupation "of the mountains; 2nd. The march of considerable col-"umns, and, consequently, the lines of operation, can only "be conducted by the principal valleys; 3rd. A passive de-"fence of mountains fails in its object, and these can only "be maintained by attacking the enemy as he advances; 4th. "Offensive operations, to be efficacious, should be directed "simultaneously in the valleys and along the heights flank-"ing them; and it is from the accidents of ground and the "respective positions that must be decided, which of these "two directions leads to the real attack."

Again, the experience of both ancient and modern times is in support of these principles, and of these observations on mountain warfare.

It is from attention to these same principles, and from knowing how to apply them properly, that in Spain, Sertorious constantly beat Metellus and Pompey; that in Albania, Scanderberg withstood the forces of the Ottoman empire; that in the Valteline, the Duc de Rohan remained master of the country, notwithstanding the combined efforts of the Spanish and Imperial armies; that in the Eastern Pyrenees, Ricardos arrested the combined efforts of the French; that, lastly, during the astonishing campaign of 1799, we saw the Generals Molitor, Desolles, Le Courbe, Soult, and Massena, occupy and defend the Tyrol, Switzerland, and the Grisons, and completely defeat in these countries the Russian and Austrian armies.

These examples prove, undeniably, that from the earliest periods to the last campaigns of the revolutionary war, offensive operations in mountain countries have always obtained decided advantages, and that the only possible mode of holding the mountains, is by an active defence, accompanied by offensive movements.

9. *On Positions.*

By a position, is meant a situation occupied by a body of troops, to effect some military object.

Success in war depends on the good choice of positions; the ground presents them, but it is for the skill or capacity of the officers to appreciate them, and determine their selection with due regard to circumstances and the objects in view.

A position is taken up either to protect some portion of a country, or to enable troops to advance with advantage to the attack of the enemy, and to oblige him to yield the ground he occupies.

Every position is either offensive or defensive, and may become a field of battle. The front of a position should never be greater than that of the troops occupying it; after deducting the reserve, the chain of advanced posts and their supports, a sufficient number should remain to occupy in compact order, the whole extent of the front and the flanks, so as to defend every point of the position with a sustained and deadly fire.

As it is not intended in this work to treat of the details of camps, nor of the rules of castrametation, information on these branches must be sought for in the "Instructions" of the Minister of War, published in November 1803, giving rules for the encamping both of infantry and cavalry; we proceed to lay down the principles by which officers should be guided in the choice of position.

To appreciate thoroughly the advantages and inconveniences of any position, those which adjoin it should also be known, that is to say, its peculiarities must be considered in relation to all that surrounds it.

By examining in detail a position where a body of troops is to be posted, as well as the surrounding country, the strong and weak points may be better appreciated; and, bearing in mind the necessary relations between the movements of the troops and the nature of the ground, it becomes easy to ascertain whether the position under examination is suitable for the object in view, be it to cover a country requiring protection, or to facilitate offensive operations.

In either case, it is necessary to consider, 1st. whether the position is calculated to fulfil the proposed object; 2nd. the details of the ground; 3rd. the modes of approaching it and of retiring from it; 4th. the communications; 5th. the local features in front and on the flanks; 6th. whether its extent is proportioned to the number of troops destined to occupy it; finally, how it is to be attacked and defended, what obstacles may be opposed to the enemy, what difficulties may have to be encountered, and how these are to be surmounted.

To these general points some more particular considerations should be added, which will enable us better to appreciate those of which we have just spoken. These particular considerations require:

1st. That there be free communications between the different points of a position, so that the troops be enabled to move with facility in every direction, and to render each other assistance; were the ground covered with fences, or intersected by ravines or streams, the communication between the different bodies of troops would be impossible; or again, were they to be separated by large intervals and obliged to make considerable detours, the enemy might succeed in forcing a point before it could possibly be supported; such objections alone are sufficient to make it desirable to select some other position.

2nd. The position should have several easy modes of ingress and egress, and its front, flanks, and rear should be free and open by means of natural or artificial outlets, a position having in its rear marshes or streams, or in short, any other cramped ground, should be avoided, as in case of retreat, it would become a long and difficult operation to draw off the troops and artillery.

Officers who know how easily troops break their ranks when retiring under fire, will feel the danger of their being retarded or separated by difficulties of ground, more particularly when closely pursued; whereas, were they enabled to retire with facility, and, preserving their ranks, to reach advantageous and contiguous points without much loss, they might form anew on these points, and make head against the enemy.

Nevertheless, we may remark, that occasionally small bodies of troops may occupy positions without any communications, and behind which there may be deep ditches, ravines or other obstacles, because it may be necessary to take possession of and retain those points; but in this case, to obviate the inconveniences which may arise from the occupation of such positions, they must be considered as isolated posts, and strong detachments must be placed in reserve to support the corps in front, to check the pursuit of the enemy, and enable the troops to rally, if repulsed; fixing, moreover, beforehand, a point of rendezvous in the rear for each of these detachments.

3rd. To ensure the advantage of ground, the position should not be commanded either from the front or flanks; for, should any high ground of superior or even equal elevation to that of the position be within range of artillery, it would be untenable. It is a received principle that a position is good only when it commands the surrounding country, or, at all events, is not commanded by it.

4th. In mountainous countries, the obstacles which cover a position, as well as the defiles leading to it, must always be under the fire of the guns on the front of the position; were the approaches out of the range of artillery, the enemy might easily pass them, and form inside without opposition.

Positions situated on heights sloping gradually downwards, unite the greatest number of advantages, and are to be preferred in every respect.

In plains, where positions have not the advantages of command, they are more or less important, according to the nature of the obstacles which cover them; but it is always essential that the ground immediately behind these obstacles should be clear, so that they may be defended by artillery placed within range, unless, indeed, the obstacles be sufficiently extensive to form long defiles, easily guarded or blocked up.

The obstacles most calculated to obstruct the advance of an enemy are, thick woods, through which the roads are few and narrow; large streams not fordable, and across which the construction of bridges would be a work of time; marshes, hollow roads, deep and scarped ravines; and, lastly, a country much intersected by hedges, ditches, canals &c.

Nevertheless, a position should not be chosen too near woods or other cover, unless these can be occupied; for the enemy might be enabled, unexpectedly, to advance and surprise the position, whilst the attention of the defenders is directed to some other point, either by false attacks or other demonstrations.

Positions in such ground require much more vigilance in guarding against surprises, concealed movements, or manœuvres, calculated to turn a flank, than in a less broken country; but at the same time it is more easy to find points of "appui" for the wings, and the difficulties of the assailant are increased, the nature of the ground diminishing his means of acting.

It should also be borne in mind, that such a position would be without any object were its front covered by impassable obstacles, such as a marsh or a rugged country, through which the troops occupying it could not themselves debouch.

In all positions the weakest points are the flanks, because the troops placed there being maintained only by their own fire, are unable to offer a vigorous resistance.

To remedy this inconvenience, the flanks should rest on points which, by their natural position, present obstacles through which the enemy will not be able to penetrate without great difficulty, such as towns, villages, streams, marshes, ravines, escarpments, and thick woods, which can neither be traversed nor turned; if these do not render the attack of the position impossible, they at least retard the progress of the assailant sufficiently to enable the reinforcements to come up before the flanks are forced, or before the movements necessary to effect a change of front or of position can be completed.

The want of points of "appui" on the flanks of a position may be remedied by placing in echellon behind the flanks one or more detachments to support the weak parts in such a manner as to enable them to overlap and afford each other mutual support: this is the best mode of preventing the enemy from forcing a flank which is without points of "appui".

In open and flat countries, where no positions can be found, small bodies of troops have difficulty in protecting themselves; as they are, however, sometimes obliged to traverse plains, the only mode by which they can obviate the disadvantages of ground is by remaining together in their temporary positions, and by making the best possible use of those accidents which all grounds present, such as hollow roads, hillocks, and streams, taking care to strengthen the flanks, and always to have the front covered.

If, on the one hand, a large army is less restricted in its choice of position, because its strength enables it to cover those points which it does not immediately occupy; on the other hand, a small body of troops being more moveable, can select and change its position with greater facility, and can take advantage of obstacles which would be useless to a more considerable body.

For instance, three battalions may take post on a ravine capable of arresting for some minutes the endeavours of the enemy, and this period will suffice for these battalions to change their positions, whilst with twenty battalions it is a different affair as far as regards the time requisite to effect the smallest change in their order of battle.

An obstacle which may chance to be behind the front of a position occupied by a corps of twenty battalions, may become inconvenient, should this corps be obliged to abandon the position, and to form column with a view of retiring; whereas, the same obstacle might prove of advantage to a smaller body which, on reaching it, might take up a position in rear and make it a point of "appui".

In the first case, this obstacle should be further off; and to be able to take advantage of the position behind it, the ground should be capable of containing the whole twenty battalions, and they should be able to reach it simultaneously in different columns and by different routes, all leading however straight to it; in the second case, three or four battalions may easily find, at a short distance, a new position, where they may arrest the advance of the enemy, and oblige him to make other dispositions.

These observations show that it is much more easy for a small body of troops to find a suitable position than for one more considerable.

Small bodies of troops are often made to occupy points which do not offer any natural positions susceptible of defence, but of which the occupation cannot be neglected on account of the relation they bear to the position of the army. It is for the officers entrusted with the occupation of such posts to supply, by their skilful disposition, what they may be deficient in, and to hold them only so long as they have to do with an enemy whose force is not too disproportioned to their own, so as not to expose themselves to a total defeat by a tardy retreat.

When circumstances render it necessary to occupy a defective position, the weak parts must be strengthened by artificial means, either by the proper distribution of the troops and the judicious employment of the three arms, or by manœuvres, which may prevent the enemy from availing himself of the inherent faults of the position.

Positions should always be chosen with regard to the object in view, and to the posts occupied by the enemy.

Should the object in taking up the position be an offensive enterprise, it is necessary to take into consideration which are the most important points to menace, and to gain possession of the outlets leading to them, being careful to reduce any obstacle which prevent their being easily reached.

Such positions can only be taken up with superior forces, but we must not on that account neglect to secure the flanks, and to cover the front by obstacles which can be passed by the the defenders only.

Offensive positions should be selected so that they may, 1st. Menace several points at the same time; 2nd. Afford the means of dislodging the enemy, of separating him from his post, and from the communications which protect and facilitate his retreat; 3rd. and lastly, may oblige the enemy, before he can quit his position, to make some movement which may give an opportunity of attacking him with advantage. But care must be taken that no opportunity be allowed to escape, and no risk should he run of forfeiting any advantage, either by occupying bad positions, or by neglecting those precautions prescribed for the safety of marches; for a corps attacking another on the line of march has always, notwithstanding numerical inferiority, the advantage of the initiative; which may be improved by selecting the most suitable ground for the engagement.

Whenever a position is taken up with the intention of acting offensively, the posts should as much as possible be beyond any rivers or streams; in short, in front of all the defiles which would have to be passed in marching towards the enemy, so that he may be more easily reached, should he decide on a retrogade movement. Although occupying an offensive position, it is not the less necessary to have the flanks protected, the front covered, and the communications in rear guarded.

When the position taken up is defensive, it is important to examine well the points to be occupied and defended, and to place the posts so as to have to traverse only the chord of the arc which the enemy would have to describe in his offensive movement.

Every defensive position should include the " field of battle," as well as the troops; and may be considered good only when the enemy can neither pass nor turn it without exposing his flank and communications.

As we have already remarked, the rear should be clear, the flanks well protected, the front favorable, and commanding, if possible, the surrounding country, that is to say, all that is within range, so that the enemy may be unable to approach either it or the flanks without defiling and engaging at a disadvantage under the fire of the troops occupying the commanding points.

These advantages of ground are obtained when the front and flanks are so covered as to leave only the smallest possible number of approaches, and when the obstacles on the flanks are sufficiently extensive to prevent the enemy from turning them without making a long circuit; should he throw a detachment on the rear of the position, a superior body should be sent to meet it, when this can be done without danger.

A defensive position should be reconnoitred and selected with particular attention, not only as far as regards the details of the ground, but also in relation to the general nature and details of the surrounding country.

It is important to reconnoitre more particularly those obstacles on the front and flanks of a position which may prevent the enemy from reaching it ready formed for action, and may oblige him to advance through defiles where his numerical superiority cannot be brought into play.

Should the position be covered by streams, the bridges above and below must be destroyed, the fords must be rendered impassable, and inundations should be formed: these obstacles contribute much to augment the strength of a position; they arrest the advance of the enemy, and keep him under a deadly fire.

Should the ground not afford any of these natural impediments, redoubts, retrenchments, or abatis, must be substituted, or commanding batteries having a cross fire on the approaches; earthworks and guns, judiciously placed, add infinitely to the advantages of a defensive position, and render it often so strong, that the enemy, though superior in number, is as much afraid to attack it as to leave it behind him; this should always be borne in view in the choice of such positions.

The position should, moreover, command all the ground to the front and flanks, so that the fire of the infantry or of the artillery, may reach every point; the ground beyond the range of musquetry should be entirely clear, or else the position should have a sufficient command to give a plunging fire on the hedges, ditches, and ravines, in front and on the flanks.

It is no disadvantage to a defensive position to have a broken and well wooded country in its rear; such a country is favorable for retreat, provided the obstacles it prevents be not insurmountable, and the ground offer a sufficient number of outlets to admit of the retreat being made with facility; but it is always dangerous to have streams or marshes in the rear, or any desciiption of ground across which troops cannot retire without defiling,

In all cases, it is advisable to reconnoitre the direction and state of all the roads, and even of the lanes which cross the front, rear, and flanks of a defensive position. It is equally essential to be well acquainted with the name, strength, and distance of every neighbouring town and village, and to examine more attentively those, which, from their proximity to the front and flanks, it becomes the more necessary to occupy.

When the front and flanks of a position are covered by villages sufficientlv near to be held, they must be occupied by detachments of infantry and artillery; but should the enemy, either in consequence of success obtained on some other point, or by any movement whatever, threaten to surround the troops placed there, they must be withdrawn.

The possibility of turning villages, and the nature of their defence, require that but a small number of infantry be placed in them; unless, indeed, it be considered of great importance to hold any particular village, which might, for instance, be the key of a position.

A knowledge of the local features of the ground with reference to the different troops is indispensable, in order to ensure skilful dispositions; for however well chosen or advantageous a position may be, its advantages are lost, should the troops occupying it be badly placed; that is to say, unless each arm be posted on that part of the ground best suited to it.

It is, therefore, the nature of the ground which decides the mode of placing each arm so as to enable it to render the most effective service, and to expose the enemy to the greatest loss, by augmenting his difficulties.

The infantry being suited to every description of ground, forms the main line of defence, it must be placed in as close order as possible in a line following the configuration of the position.

The artillery should be placed on those points whence it may produce the greatest effect, and may best command and flank the points presenting the most favorable chances to the attacking enemy.

The cavalry should be placed on ground which is quite clear, and sufficiently extensive to enable it, when leaving its postion, in order to attack the enemy, to charge, so as to reach his ranks and break them. In rough ground, the cavalry should be divided into small detachments, placed behind the infantry, so as to be able to pass easily through the intervals at the favorable moment, and fall, unexpectedly, on the front and flanks of the advancing enemy.

Cavalry placed behind infantry should support it, if necessary; for should the front be inaccessible, or even difficult of approach, cavalry can effect nothing against the enemy's infantry, but would be exposed to great loss from his fire, when posted behind hedges or ravines.

In making dispositions for an attack in a plain, reserves of cavalry must be formed; and in a broken or dangerous country, the reserves should be composed of infantry and cavalry.

It is useless, and even dangerous, to post troops on ground which the enemy cannot approach, unless such a disposition were merely made as a ruse; but if not, troops should always be posted in other situations.

When a position is covered and flanked by rivers, streams, ravines, abatis, or by retrenchments of any description, the troops must be posted so, that while all the advantages presented by these lines of defence are ensured, they may not be so close as to be impeded in their movements.

Those parts in the profile of the ground where infantry, cavalry, or artillery may be concealed, should be observed; this may often be productive of great advantages, and may disconcert an assailant not prepared for this species of ambuscade.

It is important to be able to judge in the mode of disposing troops on any ground, of their effect in perspective, when viewed from the direction of the enemy. It is easy to perceive what advantage may be derived from these effects in a mountainous country, and even in undulating ground, by presenting to the adversary illusions, instead of realities.

As a general rule every disposition of Troops should be viewed as a moveable fortification, and regulated by the principles of permanent fortifications; these principles prescribe, that as far as possible, a command should be secured, and that a position which is commanded, is to be avoided; that flanks as well as re-entering and salient angles are necessary; that the trace of the different parts of the work should be so arranged that these parts will afford reciprocal defence and protection, and yet cannot be turned or forced, but with great difficulty.

To effect these objects, the troops should be always so disposed that they may be able not only to act with freedom and to be of use everywhere, but that they may flank and support each other.

The troops charged with the defence of a position should be divided into three bodies; the strength of each depends on its duties.

The first body composed of troops placed in the position itself, in order to keep possession of it, should be the most numerous; the second, forming the reserve (which according to the nature of the ground should be composed of infantry and cavalry) is placed in rear of the centre of the position, or in rear of those points which are the most important to maintain; or again, on those where it may best cover the retreat; lastly, the third body, of which the object is to observe the enemy and protect the position from surprises, should be proportioned in strength to the extent of the chain of outposts and their supports, so as to cover the front flanks, and rear of the position.

On the approach of the enemy, these posts fall back on the position, the cavalry passing through the line to join the reserve, while the infantry lines the nearest hedges and ditches in skirmishing order; but should there be none on the front or flanks, advantage must be taken of any irregularities of ground to arrest or retard the advance of the assailant, by a well sustained dropping fire, doing them all the injury possible. As the enemy advances, the skirmishers close inward, and direct their fire on his lines or on the heads of his columns; and lastly, should he advance with weak detachments without supports, or should he neglect to protect his flanks, the cavalry should seize the favourable moment to attack him on the point where he lays himself most open.

Should the enemy follow up his movement and approach within range of musketry, then an effective and well sustained fire should be directed from the position against the point attacked; and finally, should he approach still nearer, the troops posted on the point attacked, should advance with firmness and rapidity, and without breaking their ranks, charge him with the bayonet. In this case, a portion of the infantry of the reserve will follow up this attack and fill the vacancies which may have occurred on the front line of the position.

Should the enemy be repulsed, detachments of cavalry or infantry, according to the nature of the ground, will be sent in pursuit; the troops engaged in the mêlée, should be quickly reformed and led back to the position, the preservation of which is the principal object, and that which should always be kept in view.

The reserve should not be engaged, except when its cooperation is indispensable in order to render the success decisive, or when it may have to support a body of troops, which placed in front, has been repulsed; in this case, it may enable them to rally, and may replace them in the position; in every other case, the reserve should be kept in hand to reinforce those points of the position which may require it, to support or cover the retreat; or lastly, to enable any body that may have been repulsed, to retire in good order.

In the attack of a position, as in all other military operations, skilful dispositions, accompanied by judicious execution, can alone lead to a happy result; and prudence enjoins not only to take every possible precaution to ensure the success of an operation, but also every measure calculated to obviate, in case of any unfortunate occurrence, the bad effects that might result.

On these principles, it is necessary always to be master of the line of retreat, and to direct the attack on a difficult point, rather than to sacrifice the communications, by advancing on ground presenting fewer obstacles.

The points of attack of a position are, 1st. Those which constitute its real strength, and which together form the key of the position, they require much intrepidity on the part of the assailant, who should be well acquainted with their moral importance; the attack of these points decides more promptly and more completely, the carrying of a position, but they are almost the most dangerous, and the operation should only be determined on, when, from circumstances, it is imperative to carry a position in the shortest possible time, and at any price; 2nd. The Points which must be seized in order to attack the enemy with advantage, are those which serve to flank the front of a position; as they may prove dangerous, should a retreat be necessary, it is indispensable to secure them as a precaution; 3rd and lastly, Those points which are the weakest, and which, owing to bad dispositions, have a flank open or unprotected; or again, points which are not protected by the fire of the position, and which may be approached unperceived.

Attacks directed on the extremity of a flank without "appui," are the most advantageous, more especially if the attack is made in one concentrated effort, and directed against one of the extremities of the line of a position, for this line will be rolled back as the attacking party advances, and then all the troops thus taken in flank, and deprived of the possibility of acting with effect, will inevitably be overthrown, without being able to offer any resistance. In such an attack, demonstrations must be made on all the other points of a position, in order to keep the defenders there at their post.

But to render this attack decisive, and in order to sacrifice as few troops as possible, the movements to gain the extremity of the line must be made without the knowledge of the enemy; for were this precaution neglected, he might reinforce that part, and frustrate the attack.

The advance must therefore be concealed, either by taking advantage of darkness or of the ground, or by means of a false attack on the front, or one of the flanks of the position.

The two last mentioned modes are preferable, particularly when they can be employed simultaneously, because movements made at night, are less regular than those made in the daytime.

It is dangerous to attack both extremities at once, unless with a decidedly superior force; and again it is useless to attack it in front, when it is possible, as we have just explained, to direct a concentrated effort on one of its extremities.

When small bodies of troops advance to the attack of a position, they should be led up to it in one column, or two at most, otherwise the isolated columns would not have sufficient consistence.

When a position is attacked, the advanced guard which precedes the column, should—1st. Preserve such a distance as will admit of its being supported by the column in case of need; 2nd. Drive in the advanced posts of the adversary; 3rd. Take possession of, and cover all the ground which may be considered requisite for the deployment of the columns, as well as that which may ensure safety in retreat, should it be necessary, and those points more especially which are most calculated to check the pursuit of the enemy; 4th. It should next form a chain of skirmishers, embracing in its fire the whole extent of the position; it should annoy and occupy the enemy, and by false attacks, engage his attention on those points where it is most desirable to deceive him.

During this, the commandant of the attacking force should approach under cover of the fire of the skirmishers, as near the position as possible, so as to be best able to form an opinion of its strong and weak points, and to complete his dispositions, or else change the direction of the column, following the advanced guard.

Should the ground admit of a concentrated attack on one of the points of a position, the column should deploy in the following manner, and as near the enemy as possible, seeking to cover itself where it can from the effects of his fire.

One portion should form the first line of attack; another more numerous, the second line; and in rear of this is placed the reserve.

Should the front of attack embrace a more considerable extent, the column is deployed in one line, and the reserve forms the second line.

When the columns deploy successively, and the ground during their advance towards the position, presents on the wings, points of "appui," such as marshes, streams, or ravines, they should not be neglected, if it is possible to secure them, while continuing the advance.

But should the ground be unfavourable, detachments of infantry or of cavalry, according to circumstances, must be placed in echellon, behind the wing which is deprived of natural supports, and should no obstacle exist, the advance must be made without loss of time, as soon as the deployment is completed.

Should the effect of a powerful artillery augment the difficulties of the ground, and render dangerous the approach to the position, then the artillery of the assailants must be placed on suitable points, and should, before the advance, open a vigorous fire, directed more particularly on those parts where the attack is to be made; as soon as the enemy appears shaken, the advance must be conducted with equal intrepidity and celerity, preserving always as much order as possible.

In open ground, the advance against the enemy should be made in a compact body, and he should be attacked with the bayonet: in ground much intersected, or very uneven, a chain of skirmishers should precede the column to drive in the enemy, who may be posted behind hedges, ditches, brushwood, and everything in front of the position; and they should afterwards direct their fire against the line, until the column shall have approached sufficiently near to act with effect.

The reserve should follow in rear of the centre, or of the wing destined to make the decisive attack; and in certain cases, may be made to join in the action, when it may serve, by a combined effort, to complete the success.

Should the attack have been successful, the victorious troops must be immediately reassembled and reformed, otherwise they would not be in a state to resist the attack of the enemy's reserve, which might advance against them in good order. The body which has secured the position, when reformed should advance, but with precaution, and should leave further pursuit to detachments of infantry or cavalry, according to the nature of the ground.

If the commander of the assailing party, after having renewed his attacks, and made every effort to carry the position, lose all hope of success, either on account of reinforcements having reached the enemy, or owing to unforeseen local obstacles, he should retire, rather than sacrifice his whole force in an attack which he does not expect to be successful.

As the different cases which may present themselves both in attack and defence should always be foreseen, and as dispositions should consequently have been made, and measures taken to ensure the facility of the retreat, a force repulsed from the attack of a position should retire on the principles laid down for the retreat of a corps forced from its own position.

Thus, supposing the attack on a position to be unsuccessful, and retreat deemed indispensable, as soon as the order is given, the reserve must take up a position from whence it may cover the retreat of the other troops, and may enable them to unite in its rear, and post themselves as advantageously as possible.

The reserve must at any price maintain this position until the retreating troops succeed in occupying it, when it may retire on some other point where it may equally cover the retreat, and again resist the enemy.

If the corps which retires is still pursued the retreat should continue to be conducted in the same manner until night puts an end to the pursuit, or until a position is gained capable of being maintained with advantage.

In a broken country the retreat should be made in several columns, covered by a chain of skirmishers, whilst in an open country, the infantry should be in masses covered by the cavalry.

10. *On Manœuvres, calculated to turn a Corps or a Position, and of the means of frustrating them.*

The most easy, sure, and decisive manœuvre, is turning a corps or position. By it may be avoided the risks attending a direct attack on any principal point, where the defender has all the advantages arising from the occupation of a position, selecting his own ground, covering his front with obstacles natural or artificial, protecting his flanks, and finding for them points of "appui," difficult of access, throwing up batteries which subject the enemy to a cross fire as he approaches the position in column, and ther debouches and deploys; while the attacking party, obstructed by broken up roads, inundations, abattis, and retrenchments, and unable to use his artillery, is cannonaded by that of the defenders before he can get within musquetry range.

When it is desirable to obtain possession of a position protected and defended in this manner, it should be turned, in order to avoid the loss of men, and also to oblige the troops occupying it to retire.

By turning a corps and attacking its flanks or rear with a sufficient force, a heavy blow may be dealt; but should the adversary have time and means to prevent the accomplishment of the manœuvre, it must be given up at once.

These means consist either in changing front or in a vigorous attack on the troops remaining in front of the position, weakened as they are by the detachments sent to turn it ; but, to venture on such an attack, it must be well considered whether the affair can be decided before the enemy can have effected his object ; if successful, then the detached corps must be immediately attacked, as its retreat may be thus endangered ; if unsuccessful, there may be time to retire and abandon the position, more particularly when the movement of the enemy embraces a large extent of ground, which is generally the case ; for to turn a corps a segment of a circle must be decribed, and the party who is menaced, remaining in the centre with his forces united, is superior to each of the séparated parts of the assailing corps ; he may, consequently, overwhelm them successively, or else by quitting his position, he may always make head against that body by which he is most pressed. Generally speaking, it is not by Corps detached to great distances, but by means of manœuvres on the field of battle that an adversary is effectually turned, confined to his position, or obliged to abandon it, and forced to fight until he yields.

Throwing out simple detachments on the flanks and rear of an enemy in order to make him uneasy about his communications, is the business of partisan corps, and of light troops, as their delays, or even their total loss, would not essentially effect the operations ; and, moreover, they are, from their moveable character, well fitted for expeditions of this description.

In order to succeed in turning a corps or a position, the troops destined for the attack should be directed on the flanks, or on the prolonged direction of the line of retreat.

When such an attack succeeds, particularly when directed on a point presenting no resistance in itself, the most important results may be obtained ; for the enemy being thus overthrown, is driven, from the route by which his retreat would have been safe.

But this mode of attack can only be adopted when the flanks of the adversary are weak and without points of "appui," or when his rear is not protected by a good and well reconnoitred position, occupied by a reserve.

A corps, or a position, may be turned with the whole body of troops destined for the attack, or with only a portion of them.

The first case is rare, unless when greatly superior to the enemy in numbers; for the positions which he must have taken up will necessarily be in front of the route to be pursued in order to reach him, which route would have to be retraversed in case of a repulse, and it would be highly imprudent to move off without leaving a strong detachment, when about to undertake an attack in which want of success would infallibly expose the attacking party to be cut off from his communications.

The second case, more often practised, which consists in turning the enemy with part of a force, whilst occupying him in front with the remainder, and, at the same time, covering the route to be followed in case of retreat, demands many precautions; and this enterprise should only be carried into execution with superior forces.

For, as a certain time is requisite to execute the movements leading to the point to be turned, unless each portion of the divided corps is able to resist almost the whole of the enemy's united forces, the risk is incurred of his throwing himself on one of these portions, and crushing it, while the other is still distant from the point on which it is marching.

The only mode of avoiding this danger is by taking the shortest road to the real point of attack so that all the troops may be constantly in communication, and consequently able to afford each other mutual assistance; or else by having each division superior to the enemy's united forces.

In an open country it is difficult to turn a corps or a position, even when favored by darkness, because the dispositions and manœuvres of an assailant are easily perceived and frustrated.

A position is rarely successfully turned in a broken country with strongly marked features ; in such ground a position, though not occupied in force, obstructs the efforts of an assailant, and enables the defenders to send forward reinforcements to ensure its safety.

Mixed ground is that most adapted for movements tending to turn a position. more espicially, when from its nature, the manœuvre may be concealed from the enemy without being retarded in its execution by any obstacles.

When a position is to be turned, the front should first be threatened by demonstrations, and every possible means should be employed to withdraw the attention of the defenders from the real point on which the greater portion of the force is about to act; should the enemy perceive the movement made to effect that object before it is terminated then the demonstrations should be turned into real attacks, and the points of defence rapidly approached, while they are weakened by the absence of the troops sent to support the threatened flanks or rear; those points being skilfully selected which are most weakened, and present least resistance. But the party attacked may oppose to such an attempt the means proper to frustrate it; these consist, 1st. In the strength of the position itself; and 2nd. In the skilful dispositions of the troops defending it, and in the facility of moving them.

For instance, should the enemy direct the larger portion of his forces towards one of the flanks of the position, for the purpose of turning it, leaving only a weak detachment in front ; the defenders should first protect the menaced flanks, either by re-inforcements of troops and artillery, or by making a rapid change of front, and then fall, at the right moment, on the detachment left by the enemy in front of the position.

To secure a successful result in such an operation, the troops sent to turn the position must be allowed to gain a sufficient distance to render it certain that the party attacked may be driven back, and the original ground regained before the enemy's attack shall have taken place.

A quick and bold advance, (after which, some troops should be detached against the flank of the adversary,) always produces an advantageous result; but care must be taken not to give up the position, nor yet the route which secures the retreat.

If after having lined the fronts and flanks of a position with the number of troops considered necessary for its defence, a disposable force remain, it should be sent to the wings in several detached bodies placed in echellon, so as to overlap and support each other. Thus, the enemy advancing to outflank the position, will be himself taken in flank by these detachments; and should he desire to turn them, he will be obliged to describe so large an arc, that being at a great distance from his communications, and from the troops left in front of the position, these last may be defeated before he can commence his attack.

Detached bodies placed in echellon, will always be beforehand with the enemy, whatever point he may attack, and will be better able than he to menace a flank; because in their movements, they have only to follow the chord of the arc which the assailant must describe.

The only danger of being outflanked is, when the enemy may be able to throw himself on an unprotected flank, before measures can be taken to present a new front capable of resistance; but, when the accidents of the ground give facilities for obstructing the advance of the assailant, and enable the defenders to take up new positions to a flank, then the out flanking movements of the adversary may be paralyzed by counter-manœuvres, especially when supported by the reserve, or by a re-inforcement, brought up in the most advantageous direction.

From what has been said, may be deduced this axiom, that he who turns, is himself turned. It is the more important to be convinced of this truth, and not to be alarmed in critical moments by exaggerated fears of being cut off, as it often occurs, in secondary operations, and more particularly in affairs of detail, that detachments, isolated posts, and flanking columns, lose for the moment, their communications, or designedly abandon them in favour of some important operation.

These cases occur less frequently in grand military operations, because an army can hardly sacrifice its communications, unless they have been lost through very serious errors, and it can only hope to escape from so distressing a situation by the talent and personal courage of its chief, who is bound, by honor and duty, to try everything, sooner than pass under the "Caudine Forks."

When the number of troops is only just sufficient to defend the front of a position, and form the necessary reserve, the flanks cannot be strengthened by detachments in echellon.

This formation is, indeed, not absolutely necessary for a small body of troops, which usually occupies but a small extent of ground, for whatever manœuvres the enemy may make with the intention of turning either flank, the reserve especially, if it consists chiefly of cavalry, can always advance to meet him, and in a direction calculated to threaten, or even to attack him on a flank, as quickly and easily as could troops placed beforehand in echellon, on the extremities of the line of defence.

In such cases the reserve should be careful to remain at its post, in order to be able to reach in good time, any point requiring its presence. It is for the officer charged with the defence of a position to show his abilities, by making a timely use of his reserve.

When troops acting on the defensive are no longer able to withstand the efforts of the enemy, or to oppose his manœuvres, or when in acting offensively they cannot overcome his resistance, the reserve, which is in reality intended to supply any deficiency in numbers, must, at the decisive moment, be called up to attain the proposed object.

In every description of combat the troops first engaged are generally weakened, exhausted, and even disorganized, especially if the struggle has been long and deadly; and, in this case, victory almost always remains with him who has reserved the means of making a final effort.

It is for this reason that the reserve should never be engaged at the commencement of an action, when the task of the first combatants is not beyond their physical capabilities; neither should it remain inactive until the main body is totally destroyed, because the result proposed from calling into play the reserve, should be calculated on its co-operation with these very troops, and the support it may be able to afford them: had the reserve to bear alone the whole brunt of the action, it would infallibly share the fate of the other troops.

The reserves not immediately forming part of the line of battle should take up positions whence they may be able to throw themselves rapidly, and unimpeded by accident of ground, wherever the urgency of circumstances may call them. If posted too far off, they would arrive too late to restore the equilibrium of the fight, in case of a reverse, or to complete the defeat, in case of success; the enemy being allowed time to take breath, would rally his troops and commence a new combat, where the chances would not be in favor of him who had no fresh troops to bring up.

It sometimes happens that reserves destined to support a position, are not placed close to it, either owing to particular circumstances, or the nature of the ground; but they should never be at a greater distance from the positions they are to take up in case of attack than the enemy is; unless, indeed, when the positions are sufficiently strong in themselves to be held, until their arrival. If the reserves could not possibly arrive before the combat were decided, it would be better to yield the ground, falling back on them, than to be exposed to defeat in detail.

It has been already remarked, that manœuvres, tending to turn a corps or a position, may be frustrated, by placing detached bodies of troops in echellon behind the wings as supports, or in default of them, by making use of the reserve with the same view as soon as the tendency of the movements of the enemy can be estimated. But if, from the nature of the ground, or the unpardonable negligence of the out-posts, these movements should not be discovered until the moment of attack, and should it be thought that the reserve could not arrive in time to prevent the troops from yielding the ground they have to defend, then endeavours must be made to gain as much time as possible, and to make the troops attacked in flank effect a rapid change of front.

If, on the ground occupied, there should be any point susceptible of a good defence, it should be defended without hesitation, at all hazard; but if not, then, after having effected the change of front, the enemy should be charged with the bayonet, notwithstanding his numerical superiority; this manœuvre gives time to the reserve to come up; and should the front of the position be but slightly menaced, or not at all, the part attacked should be supported by the greater portion of the corps, and it should advance, as much as possible, in the direction which will have the effect of taking the enemy in flank, and of driving him back.

It is a mistake, to suppose that the effect of a manœuvre, made with the intention of turning a flank, can be frustrated, by previously throwing back some of the troops "*en potence*;" this manœuvre is only of use in meeting a momentary danger, and should even then be employed only by small bodies of troops, and when the object is to gain time: the following are the reasons—the salient angle formed by the front and flanks is neither defended nor protected on any side; should the enemy succeed in breaking it, he will easily overthrow both, as they do not in any way support each other, and the troops cannot be moved without losing their connexion, and, consequently, without leaving an opening of which the enemy would not fail to profit.

The want of facility in moving, which is inherent in unskilful dispositions, gives the adversary the opportunity of turning, without danger, the flanks of the troops forming the angle, and of defeating, with small numbers, superior forces, when unable to move freely in every direction.

When a position is threatened on several sides at once, the point occupied should be that towards which the different attacks converge. From this point the troops may advance successively towards the enemy's columns, and beat them in detail; but, as it has been already remarked, great celerity is necessary, and the moment should be so well chosen, that the combat with the first column may be terminated, and the line of retreat gained, in case of failure, before the other columns can reach and establish themselves on this line. It must be understood that the enemy's column which most endangers the line of retreat should be attacked first, unless the enemy so commit himself, that, by defeating one of the other columns, his communications may be interrupted, when he would be forced to retrace his steps.

An advantage gained over one column inevitably leads to the defeat of the other, and allows of more freedom in the subsequent manœuvres. The success of such an enterprise depends on the successive defeat of the enemy's detachments before they are sufficiently near to act in concert and support each other. Like every other defensive movement, it should be based—1st. On the certainty of a safe retreat; 2nd. On seizing the right moment for its execution, so as to be in time to frustrate the combination, of the adversary; 3rd. On the assailant not going too far from the point serving as the pivot of his own movements, so as to be able to pass rapidly from one part to another; and 4th. On striking with vigour, because the defeat of the first column of the enemy must be completed before a second column can be attacked.

This chapter may be terminated with the following observations; admitting that a corps anxious to turn another corps is as strong as the latter, yet, when the forces of the former are divided, they will be inferior on any point they may threaten; whilst the corps in position keeping its troops united, may easily throw the larger portion of them in the point menaced, or, by a simple change of front, may present a line where the enemy thought only to find a flank. It is evident that he who is placed on the chord of the arc, which the enemy has to describe in order to turn him, will always be beforehand, having a shorter space to traverse,

These advantages are so great, that nothing but a very decided numerical superiority can counterbalance them.

11. *On Defiles.*

Any portion of ground, which, owing to local impediments, can be passed only in column, or by a flank, forms a defile.

There are two sorts of defiles.

Some consist of a communication passing through the midst of impediments, and closed in on both sides, such as roads running through valleys, and routes lying between mountains; raised embankments passing through marshes or extensive inundations; roads enclosed by ditches or by impenetrable hedges, or passing through thick woods. Defiles of this description are often practicable for small detachments only, and are sometimes met with in the course of several marches in succession.

Other defiles consist of bridges, dikes traversing marshes, villages with narrow and cramped passages, which cannot be turned. Such defiles are generally short, and are accessible only at their extremities; they admit of no means of securing the flanks, either in crossing or following them; they confine the column to a limited space, but leave the lateral approaches open. Defiles of this decription seldom fail to present themselves in all operations.

When defiles are narrow and in an open country, the fire directed from one end against the other is sometimes sufficient to dislodge the defenders; but in a broken country, or where the extent of a defile is considerable, this mode is useless,

The attack and defence of defiles devolve more especially on infantry and artillery. In the event, however, of a body of cavalry finding itself alone in front or rear of a defile, which ought to be guarded, or, of which the passage should be effected or disputed, the following are the modes which should be employed in the different cases.

In the two first cases, a portion of the cavalry should be dismounted, and in the last, the whole of the cavalry should remain in rear of the defile, out of musketry range, so as to fall upon the enemy as he debouches, and prevent him from re-forming when he has passed through.

The mode of occupying defiles depends on their nature and configuration, as well as on the object in view, whilst the rules applicable to their attack or defence, are grounded, generally speaking, on the theory of positions, and its application to the different kinds of defiles.

The object for which a defile is occupied, determines the position of the troops. This may be either the maintenance of the defile for one's own use, or the interdiction of its passage to the adversary.

When troops hold a defile for their own use, they ought to take up in its front some advantageous position, which should not be too extensive nor yet too far from the entrance, the wings being thrown back, and resting on the impassable obstacles forming the defile.

The advanced guard of this corps should come to the front of the defile, and should be so placed as to be within reach of support and protection from the position, whilst a reserve or strong detachment guards the entrance as much to prevent the enemy from gaining possession of it, as to cover the retreat, in case of necessity, and thus give the main body time to form in its rear.

When the object is merely to prevent the enemy passing a defile, of which the occupation is of no importance, the most favorable point in its rear should be occupied by the main body, in order to be able to direct a deadly fire on the enemy, at the moment when he debouches, which will be the more severe, in proportion as the front shown is more extensive.

These rules are, however, subject to the following exceptions.

Should there be, for instance, in the defile itself, or on its flanks, any tenable posts, well calculated for its defence; should their occupation be of importance to cover and insure its passage; or again, should their nature be such, that the enemy, finding them unoccupied, might, by holding them, become master of the defile, then they should be taken possession of. When several defiles cross each other, and the adversary, by holding a central point, would be enabled to throw his forces without impediment upon several outlets, this point should be held, its occupation giving the advantage of united forces, which advantage would be lost by dividing them amongst the different passes to be guarded. It is difficult to force the entrance of a defile, the flanks of which are impracticable, when the length exceeds the range of artillery, and the defenders are thus out of reach of the fire of the attacking party. This difficulty results from the occupation by the defenders of a greater extent of ground than their opponents, who, divided into columns of attack, can only debouch on a small front, and are crushed by the superior fire concentrated on them, before they are able to form and advance.

When a well defended defile is to be forced, and the artillery and infantry occupying it are covered by epaulments, a great loss may be anticipated; such an enterprise should only be undertaken when all other means are impossible, and when the advantage expected is so great as to outweigh that most important consideration.

The means employed in the defence of a defile indicate to the assailant those by which he must endeavour to weaken and overthrow them. These consist, first, in driving back the troops guarding the entrance, and then in covering the passage. To succeed in this object, the enemy must first be shaken by a superior fire, and, as soon as any hesitation is perceived in his ranks, he must be attacked in compact column with the bayonet.

The attack of a defile should be conducted in the following manner; 1st. The troops should be halted at a distance, rather beyond gunshot; 2nd. The infantry and artillery must be so placed as to be able to act with the greatest effect against the position, and more particularly against that portion of the troops which defends the entrance, seizing with address every advantage the ground may present; 3rd. The slopes commanding the position of the enemy must be gained, and the infantry should be posted in several lines, but in such situations, as will enable them to give their fire, without interfering with each other; 4th. The artillery must be so placed, as to be able to direct its fire on the front of the enemy, as well as to rake his flanks throughout their whole extent; 5th. Several sections of skirmishers should be thrown out on the flanks of the defile; and, 6th. The reserve should be sheltered from the fire of the position, but should be in a situation where it may stop the enemy, should he attempt to advance. If the defenders succeed in repulsing the lines

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MEMORANDUM.

A few surplus copies of Colonel Begbie's Translation of Piobert's "Traité d' Artillerie thèorique et pratique," have been left for disposal, and may be obtained on application at the Artillery Depôt at 10 Rupees per copy, exclusive of postage.

Subscribers to the above work are requested to remit the amount due for their copies to the Director Artillery Depôt on behalf of the Translator.

12th January, 1858.

MEMORANDUM.

Pages 488 to 509 inclusive of "Miscellaneous" as also Plate 29, under the same head will be issued in a future number as the preparation of the numerous Figures required to illustrate the subject contained therein, has unavoidably been delayed.

MEMORANDUM.

The following to be substituted for the two last paras of the DESCRIPTION of "Boxer's Fuzes for Common and Shrapnel Shells" page 37, Head "PAPERS FROM WOOLWICH" immediately preceding "*Directions for preparing and fixing the Fuze.*"

The Fuzes issued for the improved Shrapnel Shells with Tin Cylinders are smaller in diameter than those for Common Shells, and therefore must be used as Common Shells.

The Fuzes for Common Shells have a metal cap in place of a paper one. It is recommended that the bursting powder be placed in the tin cylinder before going into action, and the metal plug with the wood plug covered with serge inserted in the Fuze hole. The bursting powder can be speedily removed from the shell if necessary, and from its being separated from the balls, and consequently not acted upon by them, it will not be liable to injury even when subjected to the action of travelling.

A simple boring bit Fig. 12, is supplied to each gun, in case the one represented in the figure is lost, but this should not be used, except in case of necessity.